

RADIO SECTION
PAGE 55

Popular Science

FOUNDED MONTHLY 1872

What set shall I buy?
—An expert tells you
how to pick the right
outfit at lowest cost.

An easy way to build a
short-wave set—New
ideas in broadcasting
—Hints for everybody.

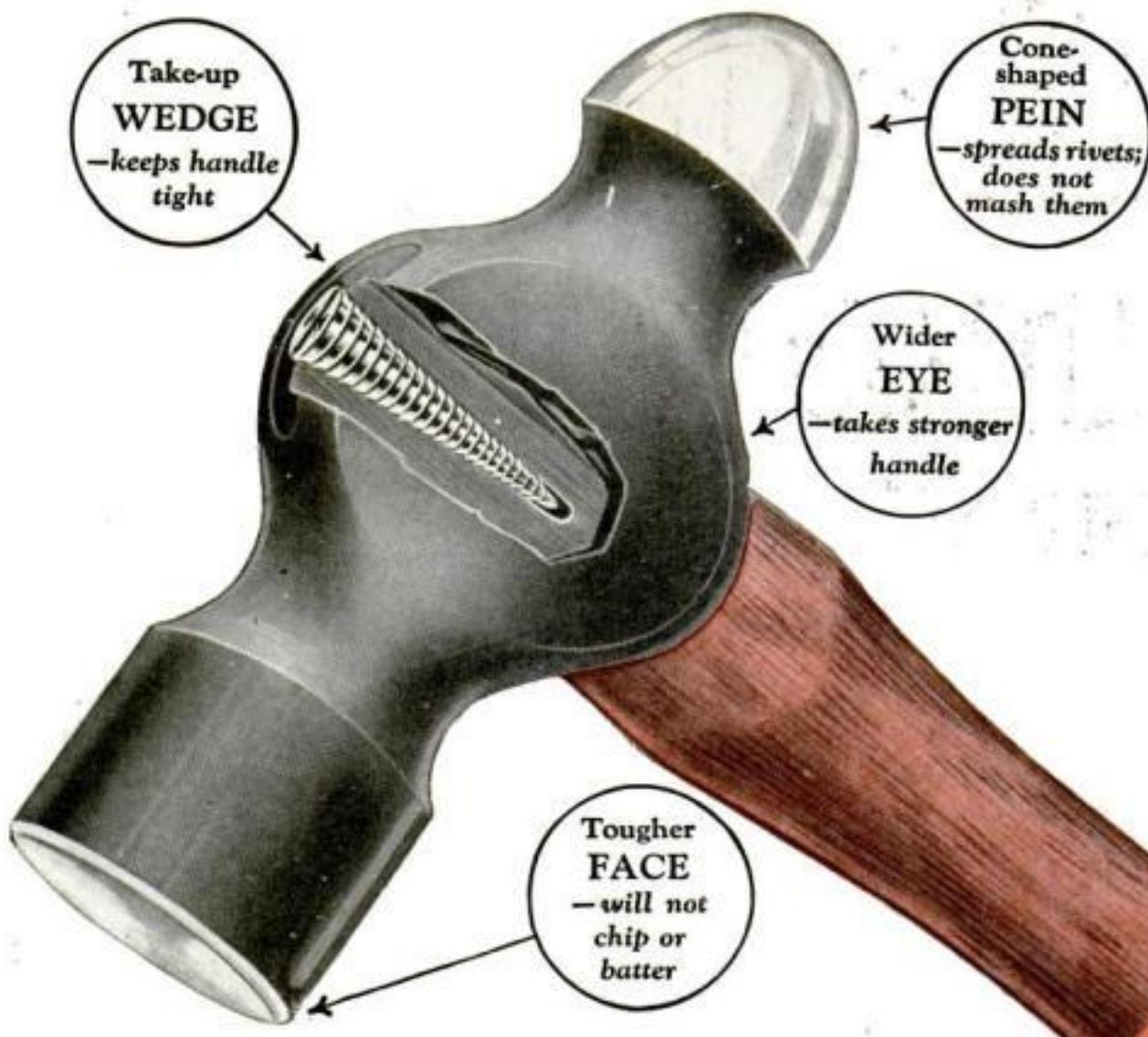


Just before the parachute opens—How aviators leap to safety through miles of sky

Where electricity gives up its magic—page 45

OVEMBER

25 CENTS



The head stays tight —it's a Plumb

YOUR blows fall true and come easy with your Plumb Ball Pein—the hammer that skilful mechanics helped us to design for you.

Off-center head adds driving power. Wider, stronger handle has more spring and "life."

Plumb Take-up Wedge keeps the black head tight on the red handle.

Try a Plumb. Feel its easy swing. Then you will know why expert workmen choose these better balanced tools and why they all say "They're worth more."

1 lb., \$1; 1½ lb., \$1.15; 2 lb., \$1.30
(except in Far West and Canada)

FAYETTE R. PLUMB, Inc., Philadelphia, U.S.A.

NO T E the Plumb Take-up Wedge shown in this hammer. The wedge pierces sharply. It is deeply treaded. When tightened in the tapered hole in the handle, the V shape of the wedge expands the wood against all sides of the eye all the way in the hammer head. The wedge takes up the slack, forcing the handle to grip and hold the head on tight.

You can retighten the handle of any Plumb Tool simply with a turn of the Plumb Take-up Wedge. Invented and patented by Plumb and used only in Plumb Tools.

**The Red Handle
with the Black Head**

(Trade Mark Reg. U. S. Pat. Off.)

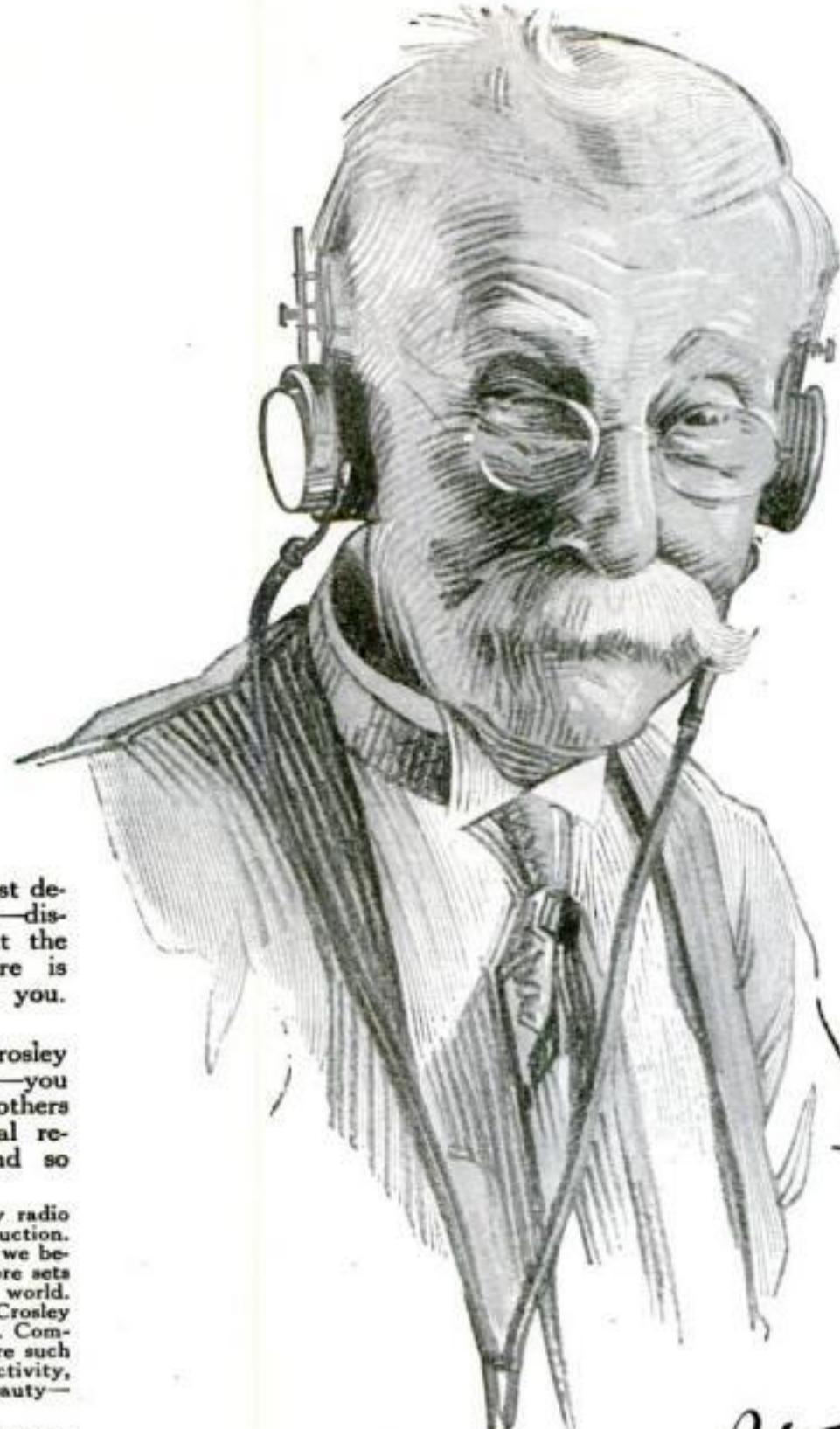
EXCLUSIVELY
PLUMB



**Look for this
Plumb display**

It is the sign of a good hardware store. It shows the Plumb selection of the nail hammer, the metal-working hammer, the camp axe and the hatchet that you should own.





To combine the two most desirable things in radio—distant clear reception at the lowest possible price—there is only one radio receiver for you. That is a Crosley.

When you listen in on a Crosley—no matter what the price—you wonder, as thousands of others have, that such exceptional results can be obtained and so reasonably.

The answer is simple—quality radio receivers built in quantity production. During the past twelve months we believe Crosley made and sold more sets than any manufacturer in the world. This is self-evident proof of Crosley Quality and Crosley Performance. Combined with Crosley excellence are such additional advantages as selectivity, ease of tuning, simplicity and beauty—all at the lowest radio cost.

Crosley has made it possible for everyone to own a radio receiver. You can start with the one tube Armstrong Regenerative Receiver at \$14.50, without accessories—\$22.25 with tube and head phones—the lowest priced regenerative set on the market, and equivalent in reception to many two tube receivers. Then as more volume is desired, you can add to it at a very low cost.

Or, you can purchase the three tube Crosley Trirdyn Regular which has come through the summer period of comparatively poor reception with colors flying—for only \$65. In special mahogany cabinet to house necessary accessories \$75. The combination of one stage of tuned radio frequency, with regenerative detector and reflexed amplification, has proven beyond a doubt that the features of selectivity, volume and ease of operation can be obtained with three tubes better than heretofore has been possible with five tubes. We believe that no other set on the market combines these features so well incorporated in the Trirdyn.

In addition there are the Crosley 51, the two tube Armstrong Regenerative Receiver that became the biggest seller in the world in just 24 days, price \$18.50. This set will at all times bring in local stations on the loud speaker and distant stations under fair receiving conditions. Distant stations can at all times be heard with ear phones; the three tube Armstrong Regenerative Receiver Crosley 52, that brings in distant stations with loud speaker volume under practically all conditions, price \$30; and the Crosley 50 and 51 set in portable cabinets at \$18 and \$25.

These receivers, each in its own class, though assuring you as good or better reception than any other instrument of the same number of tubes, is by far the least expensive ever offered to the public.

Before You Buy—Compare—Your Choice Will Be a Crosley
Crosley Regenerative Receivers are Licensed Under Armstrong U.S. Patent No. 1,113,142
Prices Quoted Are Without Accessories

FOR SALE BY GOOD DEALERS EVERYWHERE

(S) Write for Complete Catalog

THE CROSLEY RADIO CORPORATION
POWEL CROSLEY, Jr., President

1117 ALFRED STREET,

CINCINNATI, O.

Crosley Owns and Operates Broadcasting Station WLW

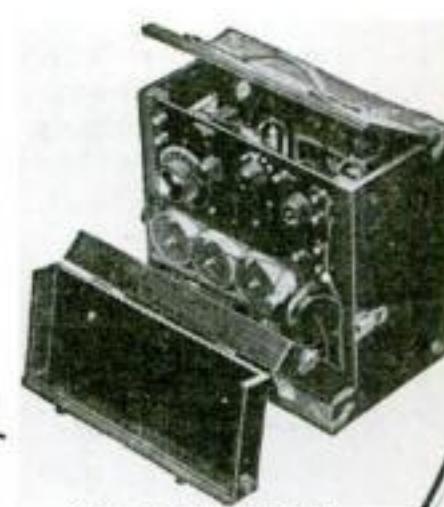
(S) This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.



Crosley Model 50
Price \$14.50
With one tube and
Crosley Head
Phones \$22.25



Crosley Model 51,
Price \$18.50
With two tubes and
Crosley Head Phones
\$30.25



Crosley Model 51-P,
Price \$25.00
With two tubes and Crosley
Head Phones \$36.75

MAIL
THIS
COUPON

The Crosley
Radio
Corporation
1117 Alfred Street
CINCINNATI, O.

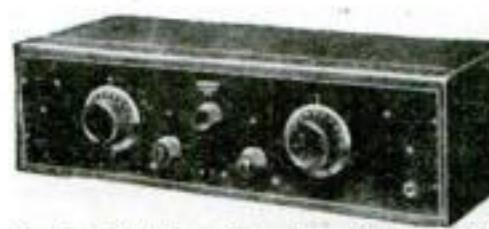
Please mail me
free of charge your
complete catalog of
Crosley instruments
and parts together
with booklet entitled
"The Simplicity of
Radio."

Name.....

Address.....



Crosley Model 52,
Price \$30.00
With three tubes and
Crosley Head Phones
\$45.75



Crosley Trirdyn Regular, Price \$65.00
With three tubes and Crosley
Head Phones \$80.75

Popular Science Monthly

Most Wonderfully Illustrated Magazine in the World

NOVEMBER, 1924; Vol. 105, No. 5
 25 cents a Copy; \$2.50 a Year



Published in New York City at
 250 Fourth Avenue

Coming Next Month

How I play radio doctor—An unusual article in which M. B. Sleeper points out the causes of most radio troubles and tells how to correct them. A story filled with helpful hints for every "fan."

Can you walk a chalk-line?—Ninety-nine out of every hundred men can't, says a famous psychologist of Johns Hopkins University, in an account of recent amazing tests—stories of remarkable discoveries about the human sense of balance and orientation.

An idea worth \$10,000—What a baby's toy did for a big-city lawyer—A dramatic story you should read if you ever have felt the thrill of inventive effort.

How typewriting betrays criminals—Extraordinary stories of the solution of mysteries by ingenious new scientific methods. Experts even can distinguish between the work of several individuals on the same machine. A vivid article portraying the march of science in an unusual direction.

And more than 200 other fascinating articles and pictures giving you all the news of radio and engineering science and invention, strange and unusual things people are doing, together with practical ideas for the automobile, the home, the home workshop, and the use of tools and machinery.



This interesting classroom photograph was sent to us recently from the Isaac Delgado Trades School at New Orleans, La., where POPULAR SCIENCE MONTHLY is used regularly as a text.

to give the students a broad, practical knowledge. This is one of several thousand schools in America where POPULAR SCIENCE MONTHLY is used regularly in their courses of instruction

POPULAR SCIENCE MONTHLY

Issued monthly. Single copy, 25 cents. Yearly subscription to United States, its possessions, and Canada, \$2.50; foreign countries, \$3. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A. Copyright, 1924, by the Popular Science Publishing Co., Inc. The contents of this magazine must not be reprinted without permission. In presenting in its editorial columns numerous stories of new products of applied science, POPULAR SCIENCE MONTHLY does not underwrite the business methods of the individuals or concerns producing them. The use of POPULAR SCIENCE MONTHLY articles, or quotations from them for stock-selling schemes is never authorized. H. J. Fisher, President; R. C. Wilson, Vice-President; O. B. Capen, Secretary and Treasurer.

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And other timely articles and pictures



A. H. Ward
Chicago, Ill.

\$12,000 a Year!

A. H. Ward, Chicago, held a small pay job. Now he averages \$12,000 a year as a salesman. Last month he cleaned up \$1,350—and he stepped into this kind of earnings as a result of reading this book.



\$1,000 in 30 Days

"After ten years in the railway mail service I decided to make a change. My earnings during the past thirty days were more than \$1,000."

W. Hartle,
Chicago, Ill.

First Month, \$1,000

"The very first month I earned \$1,000. I was formerly a farmhand."

Charles Berry,
Winterset, Iowa.



\$524 in 2 Weeks

"I have never earned more than \$60 a month. Last week I cleared \$306 and this week \$218."

Geo. W. Kearns,
Oklahoma City.



City Salesman

"I want to tell you that the N. S. T. A. helped me to a good selling position with the Shaw-Walker Company."

Wm. W. Johnstone, Jr.,
S. Minneapolis, Minn.



\$554.37 in One Week

"Last week my earnings amounted to \$554.37; this week will go over \$400."

F. Wynn,
Portland, Ore.

\$100 a Week in Only 3 Months

H. D. Miller, of Chicago, made \$100 a month as stenographer in July. In September, 3 months later, he was making \$100 a week as a salesman.

\$10,000 a Year

O. H. Malfroot, of Boston, Mass., stepped into a \$10,000 position as a SALES MANAGER—so thorough is this training.

What This Amazing Book Did for These 8 Men

It would be just as easy to tell the same story about 20,000 men—even more—but what this book brought these eight men is typical. If you do not get a big salary increase after reading this message you have no one but yourself to blame. This amazing book is

NOW FREE

IT seems such a simple thing—but the eight men on this page who did this simple thing were shown the way to quickly jump from deadly, monotonous routine work and miserable earnings to incomes running anywhere from \$5,000 to \$10,000 a year.

They Sent for the Book, "Modern Salesmanship," That You Can Now Get—Free

Possibly it is just as hard for you at this moment to see quick success ahead as it was for A. H. Ward of Chicago. When he was a soldier in France, wondering how he would make a living if he got back home safely, \$10,000 a year seemed a million miles away. But read what happened after he had read the book we want you to send for. Almost overnight, as far as time is concerned, he was making real money. In one year he made \$12,000.

There is nothing unusual about Mr. Ward, or about his success. Thousands after reading this book have duplicated what he did—Mr. Ward was simply willing to investigate.

The only question is—do you want to increase your earning power? If so—this book will quickly show you how to do it in an amazingly easy way.

Success Inside Twenty Weeks

There is no long, drawn-out wait after you have sent for this book before you begin to do as the men on this page did. Within twenty weeks you can be ready to forge ahead. This may sound remarkable—but after seventeen years of intensive investigation the National Demonstration Method has been perfected—and this means you can now step into a selling position in one-fourth the time it formerly took to prepare for this greatest of all money-making professions.

Men in every walk of life have made this change—farmers, mechanics, bookkeepers, ministers—and even physicians and lawyers have found that Salesmanship paid such large rewards and could be learned so quickly by this new method that they preferred to ignore the years they spent in reading law and studying medicine and have become Master Salesmen.

Simple as A B C

There is nothing remarkable about the success that men enjoy shortly after they take up this result-securing system of Salesmanship Training. For there are certain ways to approach different types of prospects, certain ways to stimulate keen interest—certain ways to overcome objections, batter down prejudice, outwit competition and make the prospect act. Learn these secrets and brilliant success awaits you in the selling field.

Make This Free Test at Once

You don't need experience or a college education. And if you are not sure of yourself you can find out at once whether you can make big money as a Star Salesman. Simply send the coupon for this Free Book. Ask yourself the questions it contains. The answers you make will show you definitely whether a big success awaits you in this fascinating field. Then the road is clear before you. This amazing book will be a revelation to you. Send for it at once while this free offer is open.

NATIONAL SALESMEN'S TRAINING ASSOCIATION

Dept. 15-S
53 W. Jackson Blvd., CHICAGO, ILL.



National Salesmen's Training Ass'n.
Dept. 15-S, 53 W. Jackson Blvd., Chicago, Ill.
Gentlemen: I will accept a copy of "Modern Salesmanship" with the understanding that it is sent me entirely free.

Name.....

Address

City..... State.....

Age..... Occupation.....

NERVE EXHAUSTION

How Nerve Abuse Wrecks Health

by PAUL von BOECKMANN

Lecturer and Author of numerous books and treatises on Mental and Physical Energy, Respiration, Psychology and Nerve Culture

HERE is but one malady more terrible than Nerve Exhaustion, and that is its kin, Insanity. Only those who have passed through a siege of Nerve Exhaustion can understand the true meaning of this statement. It is HELL; no other word can express it. At first, the victim is afraid he will die, and as it grips him deeper, he is afraid he will not die; so great is his mental torture. He becomes panic-stricken and irresolute. A sickening sensation of weakness and helplessness overcomes him. He becomes obsessed with the thought of self-destruction.

Nerve Exhaustion is due to nerve strain. There is no other cause for it. In men, nerve exhaustion can generally be traced to excesses and vices, although the strain of intense concentration and the worries of business life are often the chief factors. In women, Nerve Exhaustion is due mainly to over active emotions. Especially in their marital, domestic and kindred relations do women subject their emotions to constant upheavals. Indeed, we are all under severe nerve strain because of the mile-a-minute life we are leading. And no man or woman is so strong as to be immune to this strain.

Nerve Exhaustion is not a malady that comes suddenly, yet its symptoms are unmistakable. It does not manifest itself, as many think, in twitching muscles and trembling hands. The majority of sufferers from nerves seem strong and healthy, and may have not a tremor in their body, yet inwardly their nerves are in a turmoil and are undermining the entire bodily organism.

The symptoms of Nerve Exhaustion vary according to individual characteristics, but the development is usually as follows: First Stage: lack of energy and endurance; that "tired feeling." Second Stage: Nervousness; restlessness; sleeplessness, irritability; decline in sex force; loss of hair, nervous indigestion; sour stomach; gas in bowels; constipation; irregular heart; poor memory; lack of mental endurance; dizziness; headache; backache; neuritis, rheumatism, and other pains. Third Stage: Serious mental disturbances; fear, undue worry; melancholia; dangerous organic disturbances; suicidal tendencies; and in extreme cases, insanity.

If only a few of the symptoms mentioned apply to you, especially those indicating mental turmoil, you may be sure that your nerves are at fault—that you have exhausted your Nerve Force.

Perhaps you have chased from doctor to doctor seeking relief for a mysterious "something the matter with you." Each doctor tells you that there is nothing the matter with you; that every organ is perfect. But you know there is something the matter. You feel it, and you act it. You are tired, dizzy, cannot sleep, cannot digest your food, and you have pains here and there. You are told you are "run down," and need a rest. Your doctor may prescribe a drug—a nerve stimulant or sedative. Leave nerve tonics alone. It is like making a tired horse run by towing him behind an automobile.

And don't be deceived into believing that some magic system of physical exercise can restore the nerves. It may develop your muscle but it does so at the expense of the nerves, as thousands of athletes have learned through bitter experience.

The cure of weak and deranged nerves must



PAUL VON BOECKMANN

Author of Nerve Force and various other books on Health, Psychology, Breathing, Hygiene and kindred subjects, many of which have been translated into foreign languages.

have for its basis an understanding of how the nerves are affected by various abuses and strains. It demands an understanding of certain ample laws in mental and physical hygiene, mental control, relaxation, and how to develop immunity to the many strains of everyday life. Through the application of this knowledge, the most advanced case of Nerve Exhaustion can be corrected.

I have made a life study of the mental and physical characteristics of nervous people, having treated more cases of "Nerves" during the past 25 years than any other man in the world (over 100,000 cases).

The result of this vast experience is embodied in a 64-page book, entitled "Nerve Force," a book that is essentially intended to teach how to care for the nerves and how to apply simple methods for their restoration. It includes important information on the application of deep breathing as a remedial agent. The cost of the book is only 25 cents, coin or stamps. Address me—Paul von Boeckmann, Studio 165, 110 West 40 St., New York City.

This book will enable you to diagnose your troubles understandingly. The facts presented will prove a revelation to you and the advice will be of incalculable value whether you have had trouble with your nerves or not. Your nerves are the most precious possession you have. Through them you experience all that makes life worth living, for to be dull-nerved means to be dull-brained, insensible to the higher phases of life—love, moral courage, ambition, and temperament. The finer your brain is, the finer and more delicate is your nervous system, and the more imperative it is that you care for your nerves.

"Nerve Force" is not an advertisement of any treatment I may have to offer. This is proved by the fact that large corporations have bought and are buying this book from me by the hundreds and thousands for circulation among their employees—Efficiency. Physicians recommend the book to their patients—Health. Ministers recommend it from the pulpit—Nerve Control, Happiness. Never before has so great a mass of valuable information been presented in so few words. It will enable you to understand your Nerves, your Mind, your Emotions, and your Body. Over a million copies have been sold during the past fifteen years.



Aviation Brings Quick Success

TO young men of daring no other field of work offers such a fascination, such high pay, nor such opportunities for quick success as the field of Aviation. As yet, aviation is practically in its infancy. But now is the time to get in.

Amazing Opportunities in Airplane Industries

In the automobile industry and in the moving picture business hundreds of men got rich by getting in at the start. They made their success before others woke up. Today, these lines offer no greater opportunities than a hundred and one others. BUT AVIATION IS NEW. Get in while the opportunities are big. All over the country there will be a clamor for trained men. It will not be a question of pay but of getting capable men.

Become an Aviation Expert \$50 to \$100 per Week

The study of aviation is almost as fascinating as the actual work. Every lesson is full of interest. That is why it is easy to learn aviation. You do not have to make yourself study—it is like reading an interesting book that tells you things you have always wanted to know. Only one hour each evening will give you the basic training in a surprisingly short time.

One student, S. F. McNaughton, Chicago, says: "Your lessons are like a romance, and what is more, after one reading, the student gets a thorough understanding. One never tires of reading them." James Powers, Pa., another student, says, "I am indeed surprised that such a valuable course can be had from such practical men for so little cost."

Fascinating—Daring—Big Paying

Prepare Now for One of These Positions

Aeronautical Instructor	\$60 to \$150 per week
Aeronautical Engineer	\$100 to \$300 per week
Aeronautical Contractor	Enormous profits
Aeroplane Repairman	\$60 to \$75 per week
Aeroplane Mechanic	\$40 to \$60 per week
Aeroplane Inspector	\$50 to \$75 per week
Aeroplane Salesman	\$5000 per year and up
Aeroplane Assembler	\$40 to \$65 per week
Aeroplane Builder	\$75 to \$200 per week

Personal Instruction

by Experienced Men

Men who have had actual experience give you personal attention. They select the lessons, lectures, blueprints and bulletins. They tell you things that are essential in everyday practice. Each lesson is easy to read and understand.

Get Big FREE Book—Now

Send coupon below for New Book, just out, "Opportunities in the Airplane Industry." It is interesting and instructive. It will show you many things you never knew before about aviation. We have but a limited supply of these books—send the coupon before they are all gone.

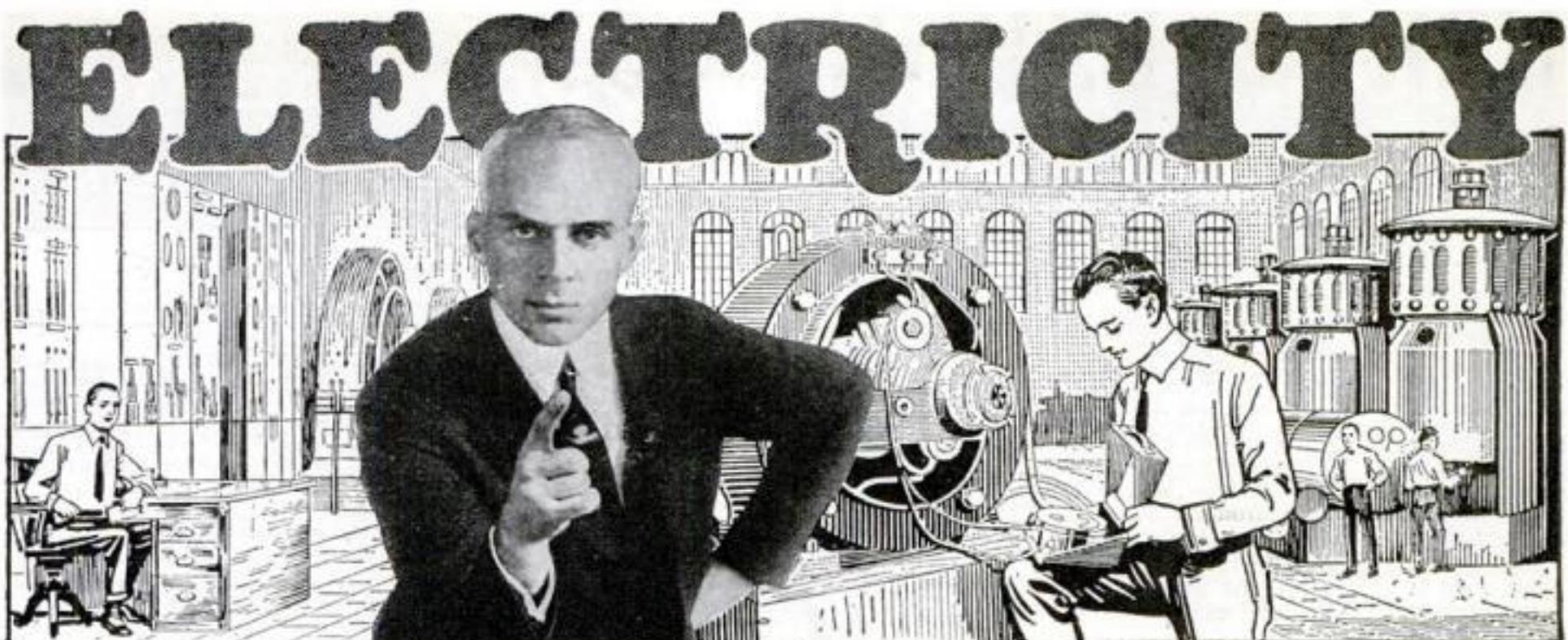
American School of Aviation
3601 Michigan Ave., Dept. 13-68 Chicago, Ill.

American School of Aviation
3601 Michigan Ave., Dept. 13-68 Chicago, Ill.
Without any obligation, send me your Free Book,
"Opportunities in the Airplane Industry", also information about your course in Practical Aeronautics.

Name.....

Street.....

City..... State.....



Let Me Show You How to Make It Bring You \$9000 a Year

You men who are slaving away in small-pay jobs, hoping and striving for better things, I wish you could be with me here for just a few moments. I would show you how thousands of men just like yourself have quickly stepped into high-salaried positions and brilliant success in this fascinating field of electricity. In each and every case their first step toward

Be an Electrical Expert Learn at Home

Get into this great field of Electricity! Know the magic force, the ways and means it is harnessed for use in industry, and a thousand jobs will be opened to you at salaries far beyond your fondest dreams. Read Pence's story at the right! Let it be your guide post to success! Hundreds of other Cooke-Trained men have done as well, and many better! And how? Simply by taking this specialized training that quickly fits any man, no matter what his age or previous education, to take his place with the big-pay men of the country. You needn't give up your present job or go away to school; by this amazing method you may learn right at home in your spare time.

\$3500 to \$10,000 a Year

Twenty years of actual work all over the world in the electrical field gave me a grasp of just what a man must learn to fill an important position. My experience taught me that a man must know first the principles involved and then the best methods to apply and regulate those principles. Why make a man wade through a lot of useless study, wasting months of precious time. And so, at enormous expense and years of effort I evolved a system of training that is stripped of every useless step. I will make the student a practical worker! I will place in his head and hands the means to make big money as a skilled Electrical Expert! I will fit him in a short time to earn a princely salary, \$3500 to \$10,000 a year, for his skill!

Thousands of Happy Men Say "There Is No Other Training Like This"

"You have given me a most wonderful training, a training no other school can, I feel sure, approach, much less duplicate," says F. E. Radcliffe, one of my boys who is making good in Ohio. I wish you could see the thousands of letters I get like this! John Burke of Baltimore made \$750 in spare time before he finished his training! Think what this means to you! No frittering away time serving a costly apprenticeship! Every step in this fascinating training adds earning power. You quickly become a practical man, ready to fill a big-pay job.

Many of my boys set up in the Electrical Contracting business, wiring houses, repairing motors, generators, electrical appliances, installing farm lighting systems, etc. Others set up shops and spaces in garages for repairing electrical systems on automobiles, trucks, motorcycles, etc. They are fitted at once to start in business for themselves, with practically no investment. And with the big plants, even the ordinary electrician makes big money. But the Trained Expert is the man who is Boss—he is the big-pay man. With the training behind you, you can claim such an enviable place for yourself.

this cherished goal was to write to me for the same *free proof* I want to send to you. They followed my advice and today are leading happy, prosperous lives—many drive their own cars, own their own homes and have plenty of money to spend for the other good things of life. They are Electrical Experts—"Cooke-Trained"—earning \$3500 to \$10,000 a year!

You Cannot Lose—I Guarantee Your Complete Satisfaction

You don't have to take my word for one thing. So sure am I that after taking this training you can step right into a high-salaried position, and you will thrill with the newly found power that is yours, that I guarantee under bond to return every cent of tuition you pay me, if you are not absolutely satisfied that it is the best investment you ever made. Electricity needs you—it offers you boundless opportunity for a brilliant career. I have tried to remove every stumbling block toward accomplishing your ambition. I will help you win, if you will let me!

FREE—if You Act Now—FREE Big Electrical Outfit

I know that it is only by practice with actual instruments and materials that a man can become a *practical electrical expert*. For that reason I give you without charge or stipulation a Complete Outfit of Electrical Tools, Materials, and Measuring Instruments. I also furnish you with supplies, examination paper and many other things that other schools don't furnish. You actually start early in the course to work at your profession, rapidly becoming proficient, ready to do any electrical job.

EXTRA—A Course in RADIO Given FREE for a Short Time

The up-to-date Electrical Expert must know radio or wireless work, how to make and repair the various equipment. This is a mighty profitable field today, and many men are making big money in it. Because I want to make this my banner year, I am now giving this \$45.00 Course in Radio *absolutely Free* to new students. Don't miss this remarkable offer which might be withdrawn at any time.

Make up your mind now to get into this great profession quick. Every day lost keeps you away that much longer from prosperity and happiness! Mail the coupon today for my big free book, "How to Become an Electrical Expert," and other free proof that I can put you into the class with Pence and thousands of other Cooke-Trained men who are making princely incomes.

L. L. COOKE,
Chief Engineer,
CHICAGO ENGINEERING WORKS,
Dept. 38, 2150 Lawrence Ave.,
CHICAGO, ILL.



\$9000 A YEAR

The picture above shows Mr. W. E. Pence of Albany, Oregon, in his working togs. Pence is a "Cooke-Trained" man, and his letter below shows what he thinks of my course.

Dear Mr. Cooke:

Thought you would be interested in a hand-bill I have just gotten out regarding my new shop. Business is going strong, paying me now something over \$750 a month above my expenses.

And I must thank you again for my success, because it was your wonderful course and method of instruction that put me where I am.

Your true friend,

W. E. PENCE.

L. L. COOKE, Chief Engineer
Chicago Engineering Works, Dept. 38
2150 Lawrence Ave., Chicago, Ill.

Send me at once "How to Become an Electrical Expert" with other proof that I can become a big-pay Electrical Expert through your Training. Register me for your Special Free Offers. You send this FREE without any obligation on my part.

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The "Cooke" Trained Man is the "Big Pay" Man



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AUTOMOBILE Parts—Used parts for most any car at half factory list prices. Allen, Briscoe, Buick, Cadillac, Chalmers, Chevrolet, Dodge, Dort, Grant, Hudson, Hupmobile, Oakland, Overland, Oldsmobile, Reo, Studebaker and many others. Send list of parts wanted. Century Auto Parts Co., 4105 Olive Street, St. Louis, Missouri.

MONEY!—Silvering autolights, radiators, mirrors. Refinishing tableware, stoves, brass beds, etc. Outfits, Methods free. Write—Sprinkle-Piater, Dept. 96, Marion, Indiana.

VULCANIZERS, tools, materials, supplies, tires, tubes direct from factory. Miller-Anderson Rubber Works, Anderson, Ind., Dept. P.S.-3.

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HULIT & Co., 625 Jackson, Chicago, Ills. Experimental Machinists Model Makers. Dies. Patterns. Complete general Machine shop. Ex-Lamson.

WE make working models for inventors and experimental work, and carry a complete stock of brass gears and model supplies. Send for catalogue. The Pierce Model Works, Tinley Park, Illinois.

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MOTORS—Manufacturer's Surplus Sale. 1/HP. \$8.50. 1/2 HP. \$32.50. 1 HP. \$54.50. 8 Volt Charging Generators, \$8.50. Complete Lighting Plants—Generators—Light Machinery. Write for Catalog. Motor Specialties Co., Crafton, Penna.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Avenue, New York.

DUNKIN Engineering Co. Patents Developed—Models Furnished—Spec. Machinery. 13000 Superior Avenue, Cleveland, Ohio.

MANUFACTURING

DIES, Tools and General Manufacturing. Models and manufacturing of new inventions our specialty. Logan Machine Co., 126 S. Clinton St., Chicago, Ill.

DEVELOPING Ideas and manufacturing our specialty. Absolute satisfaction. 33 years' experience; write us. The K. & B. Die & Specialty Co., 2018 Elm St., Cincinnati, Ohio. Dent C.

We design and build special machinery, tools, dies, jigs, and fixtures. Experimental work. Reliable Machine Co., 400 West 23rd Street, New York, N. Y.

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BARGAINS. No. 34 Garvin Milling Machine, \$185.00. 20" Drill press, \$50. 13" x 5' Steptoe engine lathe, \$125. Complete line machinery. Cincinnati Machinery Supply Co., 217 E. Pearl St., Cincinnati, O.

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AIRPLANES. Flying Boats, Motors, Aircraft Supplies. Balloon baskets, \$50. Compass, \$15. Unshatterable goggles, jumbo, \$3.50, wide-vision, \$5; leather helmets, \$4.50. 26x4 wire wheels, \$6.50; used casting, \$2; new tubes \$2. Floyd Logan, 716 W. Superior, Cleveland, Ohio.

THE American School of Aviation announces a new correspondence course in mechanics of aviation. A thorough training in practical aeronautics. American School of Aviation, Dept. 674-B, 3601 Michigan Ave., Chicago, Illinois.

BOYS get a three foot model aeroplane free. Nothing to sell. Write to Aero Shop, 3050 Huribut Ave., Detroit, Michigan.

WANTED

WANTED: Light Machinery, Lathes, Drill Presses, Model High Speed Gasoline and Steam Motors. Best Cash Prices Paid. Motor Specialties Co., Crafton, Penna.

AGENCIES Wanted. Submit particulars. Grenada Bros., Manufacturers' Representatives, Burton, Demerara, British Guiana.

DETECTIVES needed everywhere. Experience unnecessary. Particulars free. Write, George Wagner, former Government Detective, 1968P Broadway, N. Y.

WANTED—Inventors' Experimental work, wood, metal patterns, machine work, rubber mill under one roof. Send drawings. Miller-Anderson Rubber Works, Anderson, Indiana. Dept. P.S.-3.

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OPPORTUNITY to start Manufacturing Metal Toys and Novelties. No experience necessary. Enormous demand exceeds supply. We furnish, at cost, casting forms for production and buy entire output, also place yearly contract orders. Casting forms made to order. Catalog, advice and information free. Metal Cast Products Co., 1696 Boston Road, New York.

Money Making Opportunities

for "Popular Science" Readers

Another \$25.00 IN PRIZES

To win one of these cash prizes is easy, and every reader is invited to enter this fascinating competition. Just write a letter of not over seventy words answering this question:

What Advertisement of "Money Making Opportunities" in this issue interests you most and why?

Here are the prizes we will pay for the ten best letters answering the above question:

First Prize	\$10.00
Second Prize	5.00
Third Prize	3.00
And 7 Prizes of \$1.00 each	7.00

First read every one of the "Money Making Opportunities" advertisements on pages 6 to 24. Check the ones that interest you. Then read over the ones you have checked and decide on the one that interests you most.

Then write a short letter, not more than seventy words, telling us why the advertisement you pick interests you most. Remember that ten prizes will be awarded. You have a good chance of winning one of them. Be sure to mail us your answer before Nov. 1st. The prizes will be awarded, in the order of their merit, for the letters that are most interesting and best expressed.

The names of all the prize winners and the letters that win the first two prizes will be printed in this column in the January issue. Address your prize letter to

Contest Editor

POPULAR SCIENCE MONTHLY
250 Fourth Ave., New York City

Last Month's Prize Winners

The First Prize of \$10.00 goes to Mr. Vernon Bradley of Decatur, Illinois, for his letter regarding the advertisement of W. Stedman Richards. Here is Mr. Bradley's letter:

Dear Sir:

I have carefully read the "Money Making Opportunities" in Popular Science Monthly. The advertisement of W. Stedman Richards interests me most because of formula which I purchased for \$5.00 is making me financially independent. I had spent nearly \$4.00 and two years of experimenting which could have been saved. I owe it all to the common sense of this advertiser to advertise.

VERNON BRADLEY.

Miss Margaret L. Smith, of St. Paul, Minnesota, wins the Second Prize of \$5.00 for her letter on the advertisement of the Handy Specialty Company. Miss Smith's letter follows:

Dear Editor:

"Money Making Opportunities" threw a life-saver to me in the form of a 'gas gun' offered by The Handy Specialty Co., saving steps, time and temper. Previously my sisters ran the car 'gas dry' and when I drove, I was invariably stalled at an inopportune place without gas.

Now thanks to helpful advertising in "Money Making Opportunities" in Popular Science, I can leave the garage without fear of being stalled.

MARGARET L. SMITH.

The Third Prize goes to Martin Aaron of Brooklyn, N. Y., for his letter on the advertisement of the Fyr-Fyter Company.

The winners of the other seven prizes are:

Edward York, Alleghany, Va., C. L. McKnight, Jr., Beverly Hills, Cal., Charles Reynolds, Spruce Creek, Pa., Mrs. J. F. Lovell, Danville, Va., Miss Charlotte Hall, West Upton, Mass., H. D. Chapman, Berkeley, Cal., Miss Virginia Bowes, North Topeka, Kansas.

Rate 30 Cents a Word. A 10% discount is allowed on all contracts for six consecutive insertions. Advertisements intended for the January issue should be received by November 5th.

RADIO AND SUPPLIES

68 STATIONS on Crystal without tubes or batteries. You fellows who haven't tried my hook-up don't know what you are missing. Write, Leon Lambert, 670 Volturna, Wichita, Kansas.

RADIO tubes, D11, D12, UV194, UV200, UV201A, \$4.25. Dutch radio tubes, D12, T1200, D201A, \$2.50. Crystal set, 50c. Add postage. Radio Sales Co., 1168 North Kingshighway, St. Louis, Mo.

RADIO Generators: 500r 100 watt \$28.50. Battery Charging Generators, \$8.50. High Speed Motors. Motor Generator Sets all sizes. Motor Specialties Co., Crafton, Penna.

2,650 MILES Distance with one tube. Any writing understands our Simplified Instructions, including Panel Layout and Photo, 25c. Vesco Radio Co., Box F8 117, Oakland, Calif.

PIJUR Generators, brand new 2 v.c.t.s maximum output 22 amperes at 2000 r. p. m. complete with automatic cutout for charging A battery. Government surplus price \$10.00. Cook County Sales Company, 2454 Calumet Avenue, Chicago, Ill.

RADIO Callig—Game—Map—Score Sheets Instructions, etc., 35c. Agents wanted. Dept. 1, 918, Garrick Chicago.

EDUCATIONAL AND INSTRUCTION

DOUBLE entry bookkeeping mastered in 60 hours guaranteed; diploma. International Bookkeeping Institute, Springfield, Missouri. Desk 10.

LINCOLN-JEFFERSON University. Home Study in Academy College, Theological, Law, Music, Pharmacy, Business and Graduate schools, leading to degrees. Box G, Capitol Building, Chicago.

FIREMEN, Brakemen, Baggage men, Peepers car train porters (colored). \$140-\$200. Experience unnecessary. 838 Railway Bureau, East St. Louis, Ill.

DRAFTING, Tool Designing and Mathematics taught by mail; combined course or separate subjects. Harding School, Box H, Highland Park, Michigan.

BE a detective. Excellent opportunity to earn big money, travel, thousands of dollars offered in rewards. Established 1909. Particulars free. Write to C. T. Ludwig, 424 Westover Bldg., Kansas City, Mo.

ALL men, women, boys, girls, 17 to 65, willing to accept Government Positions, \$117-\$250 per month. Information free. Write immediately. Chicago Civil Service College, T-70 Kemper Building, Chicago.

MEN 18-35. Become railway Postal clerks. Commence \$1600 year. Common education sufficient with our coaching. Particulars free. Write immediately. Franklin Institute, Dept. R39, Rochester, New York.

RAILWAY mail clerks, \$133-\$192 monthly. Many other openings, \$117-\$250 per month. Information free. Write immediately. Chicago Civil Service College, T-70 Kemper Building, Chicago.

YOUR Handwriting Portrays Your Character. Send Ink Sample of own or friend's writing for expert analysis with 25c for astounding demonstration of dominant characteristics. Real guide to success. B. PenCraft, Collins, New York.

USED correspondence school courses save over half. Bargain catalogue 1000 courses free. Used courses bought. Students' Exchange, Dept. A, 47 West 42d Street, New York.

DETECTIVES earn Big Money. Excellent opportunity. Travel. Fascinating work. Experience unnecessary. Write, George Wagner, former Government Detective, 1968P Broadway, N. Y.

QUICK profit, guaranteed workable. Mail Order plans with complete detailed instructions in modern successful methods. Ten years of research and experience. Southwest Bonded Mail Order Service, Box 321A, Oklahoma, Okla.

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TRADE AND TECHNICAL SCHOOLS

CHICAGO Technical College offers short, intensely practical courses in Drafting and Engineering—civil, mechanical, electrical, structural—Architecture, Building Construction, Plan Reading, etc. Courses fitted to your needs. No time wasted. Instructors are experts. Graduates in demand at big salaries. Opportunities for part-time work while studying. Day and evening classes. 21st year. Enter any time. No special preliminary training required. Low tuition—easy terms. Write for 52-page Illustrated Blue Book, describing opportunities open to our graduates. Chicago Technical College, 28 Chicago Tech. Building, Chicago.

EARN ten to fifteen dollars per day laying brick. Any intelligent man can become a bricklayer with three months training in our school, and three to six months practical experience, during which he can earn 60 to 90 cents per hour. No age limit. Tuition reasonable. Send for catalogue. Associated Building Employers, 128 A. B. E. Bldg., Grand Rapids, Michigan.

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ELECTRICITY—Learn at home in your spare time. Get into this great field of opportunity and big pay. No special experience or education necessary. \$3,000 to \$10,000 a year paid to experts. This is your one big chance to get out of the low pay rut. Send for big free book on Electricity—it is free. S. & H. Engineering Co., Dept. CN-16, 1422 W. Monroe St., Chicago, Ill.

PINMANSHIP

YOUR signature (12 styles), finest you have ever seen. Send quarter, Meub, Expert Penman, 2051 Lake, Pasadena, Calif.

More Money Making Opportunities on pages 8 to 26



The Most Fascinating Story of Human Progress Ever Written!

Where did you come from? What savage ancestors slumber in your soul? How did you get your name? What external forces have for ages been moulding you, changing you, making you into what you are?

"The Customs of Mankind"

COME back with us to the dawn of life! See man in the very birthplace of his existence, follow him through savagery to civilization, watch him emerge from beast to man—see your own self in the making!

"The Customs of Mankind" is a remarkable new book unlike any you have ever read or seen. The author has searched behind the pages of history, has gone back to the cradle of life, and has written truthfully and simply of the many amazing things she has discovered. And these things concern *you*—concern the impulses and instincts that crowd through you today—concern the habits and customs observed by you today—concern the manners approved and accepted by a highly polished society.

Do you know how fire was discovered? Why man began to clothe himself? When faith was born? How primitive man explained the miracle of birth, the mystery of death? How our marriage customs came into being? When man began to talk? How the kiss originated? Do you know why you

do certain things, say certain things, want certain things?

First Edition Offer to You

"The Customs of Mankind" will hold you breathless from cover to cover. There are 133 remarkable illustrations, 753 pages of extraordinary text, 10,000 tales about yourself—an education in one beautiful and astonishing volume.

You must see it. Take advantage of this special offer. No money is necessary. Just mail this coupon today, and a copy of the attractive first edition of Lillian Eichler's wonderful new book, "The Customs of Mankind," will go forward to you at once. When it arrives, give the postman only \$2.98 (plus few cents delivery charges) in full payment. This is the biggest book value of the year—judge for yourself, and if you aren't delighted, return it within 5 days and your money will be refunded at once.

Mail this coupon before you forget—and add a fascinating and valuable book to your library. Nelson Doubleday, Inc., Dept. A-2511, Garden City, New York.



Nelson Doubleday, Inc., Dept. A 2511,
Garden City, New York.

I would like to see the beautiful first edition of "The Customs of Mankind" by Lillian Eichler, attractively bound in blue cloth with gold lettering. I will give the postman only \$2.98 (plus few cents delivery charges) in full payment on arrival. I have the privilege of returning the book within 5 days and having my money refunded if I am not delighted. I am to be the sole judge.

Name.....

Address.....

City..... State.....

Check this square if you want this book with the beautiful full leather binding at \$4.98 with the same return privilege.

Titles from the table of contents

- The childhood of man
- Daily life of primitive man
- Fear and superstition
- The age of dream interest
- The evolution of religion
- The first human relationship
- Man's first language
- The discovery of voice
- The girl in primitive life
- The first kind of courtship
- The antiquity of human marriage
- Love enters marriage
- Wedding customs and their origins
- Food and civilization
- The playdays of humanity
- Life's dance
- The habit of dress
- Survivals in games
- Popular superstitions
- and a wealth of other interesting subjects!



Fourteen Words of Magic Power

—that is what the multi-millionaire gave to the young man who saved his life. He wouldn't give him MONEY because given money usually breeds neglected opportunities. He couldn't give him a JOB because the young man didn't know enough. So he gave him instead that which had enabled himself to create his multi-millions: FOURTEEN WORDS OF MAGIC POWER, and when that young man understood and used those fourteen

HALF A MILLION DOLLARS IN FIVE YEARS.

READ ABOUT IT FOR YOURSELF

Here are just a couple of pages. The BOOK you may have FREE if you like.

"Listen, young man, you have saved my life...." Arthur had forgotten that in his interest in the conversation. ".... and I want to reward you."

"I hope you won't—" began Arthur, fearing that he was about to be dismissed with some small present of money.

The other understood. "No, I am not going to insult you by offering you a few dollars. I couldn't give you a great deal of money without taking from you with the same hand most of your incentive to make something of yourself and of your life."

Arthur would have liked to argue that point,

It won't cost you a cent to do so and it may be worth half a million to you as it was to Arthur Holmes. You can understand these Magic Words, and you can use them; if you do they will make you rich and famous, useful and happy, indeed they will bring you whatever you want.

but obviously there was something more coming, and he was too keenly interested.

"Instead, then, I am going to give you something which will give you whatever you want. Call it an amulet . . . a talisman . . . a magic rune . . . call it whatever you like, but believe me when I tell you that this . . . secret . . . which I am going to give you is the secret of my success and of the success of everyone in the history of mankind who has ever really succeeded. . . even of nearly all of those who only thought they did."

—Read the rest of the story—the FOURTEEN WORDS and what they did—and may do for YOU!

CHICAGO TECHNICAL COLLEGE,
Dept. 1131, 118-132 East 26th Street, CHICAGO

Send me FOURTEEN WORDS OF MAGIC POWER. It's agreed that I pay you nothing and owe you nothing in return.

Your name Age

Present occupation

Home address

City State

To get this interesting and valuable little book absolutely free, fill out this coupon or give same information on card or in letter.



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Learn at home to mount birds, animals, game heads; tan furs, make rugs and robes. Complete lessons. Easily and quickly learned by men, boys and women. Write for Free Taxidermy Book. Tells all about it. Every sportsman, trapper and nature lover should know this wonderful fascinating art. Save your trophies. Big profits. Success guaranteed. 75,000 free copies. Investigate. Write for Free Book. Northwestern School of Taxidermy 1788 Elwood Bldg., Omaha, Neb.

Money Making Opportunities

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ADVERTISE in 24 metropolitan dailies, 24 words, \$15.00. Helpful Guide listing 1000 publications, 46 stamps. Wade Company, Baltimore Bldg., Chicago.

28 WORDS in 80 Country Town Newspapers, \$3.40. Shaw, 221 A. Northeast, Washington, D. C.

ADVERTISING rates for magazines and weeklies free. Charles A. Lutz, Apartment 241, York, Pennsylvania.

24 WORDS combine list of 70 Sunday and weekly newspapers, \$6.00. AdMeyer, 4112 P. Hartford, St. Louis.

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INCH display 100 magazines thrice, \$8. Beck, 5400 Alaska, St. Louis.

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COMMERCIAL Printing. Write requirements. Franklin Press, B-34, Milford, New Hampshire.

BETTER Printing for Less Money. Write us about your printing needs, and you will save money. Ernest Pantus Company, 525 South Dearborn Street, Chicago.

EMBOSSING business, personal stationery. Samples, stamp. Daniels P. Company, Pittston, Pennsylvania.

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AMERICA'S leading Mail Printers Want Your Work. We have every facility, we give you highest quality, lowest prices and guarantee satisfaction. Bond Letterheads and envelopes, 1,000, \$3.50; 5,000, \$14.50. Get our estimates on other work first. Chadsey-Meador Co., New London, Conn.

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BEAUTIFUL registered bull pups cheap; Bulldogs 501 Rockwood, Dallas, Texas.

FOR sale, high class Fox and Beagle bounds, partly and well broken; puppies of all breeds; I ship C. O. D. See the stock before you pay. Stamps for circular. Landis-Kennels, Mohnton, Pennsylvania.

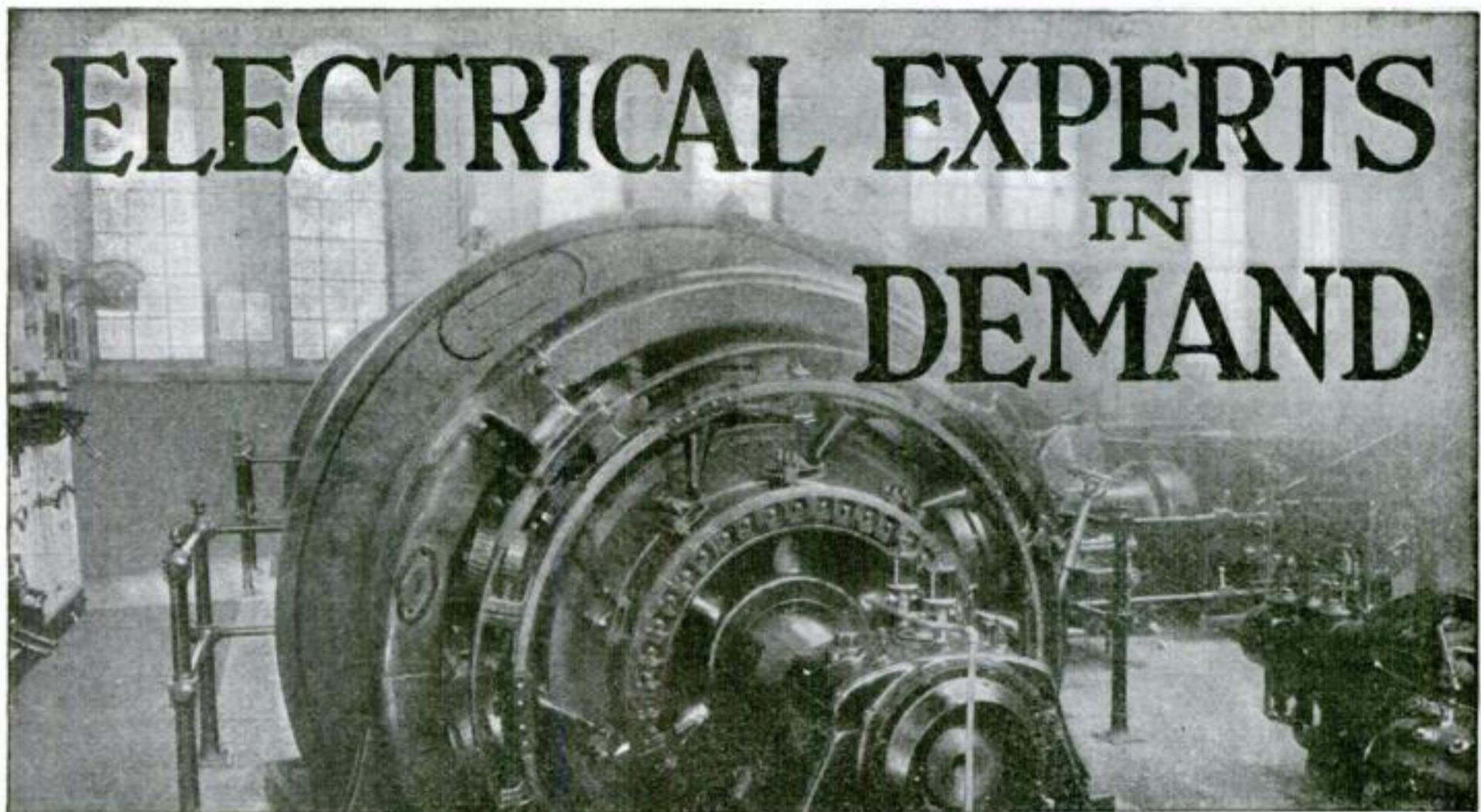
THE World's Largest Dog kennels offer for sale Oorang Airedale watch dogs, automobile dogs, children's companions, farm dogs, stock drivers, hunters and retrievers. Also Big Game Hounds, Coonhounds, Foxhounds, Rabbit Hounds and thoroughbred Hound and Airedale puppies. Satisfaction and safe delivery guaranteed to any point in the United States. Large illustrated descriptive catalog free. Oorang Kennels—Box 208—La Rue, Ohio.

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TRICK cartooning made easy. Two New Programs with Beginners' Instructions, \$1.00. Footlight Cartoons, Portsmouth, Ohio.

More Money Making Opportunities
on pages 6 to 24



ELECTRICAL EXPERTS IN DEMAND

Salaries of \$12 to \$30 a day not unusual

There are not enough men available to meet the demand. A wonderful opportunity for trained men.

IN A COMPARATIVELY few years, the electrical industry has developed from the experimental stage to one of the biggest industries in the country, giving employment to 250,000 people.

Wonderful as has been its past, the future of electricity will be even more remarkable. As Thomas Edison says—

"Fathers sometimes come to me or write to me about their sons and want to know if I would recommend electricity as a career.

"Well, if I were beginning my career again, I should ask no better field in which to work. The chances for big, new electrical inventions are much greater than before the telegraph, the telephone, the electric light, the electric motor and radio were invented."

There is no doubt that electricity offers a wonderful opportunity, and young men who start now and train themselves to become expert in it are assured of a profitable future.

It is universally acknowledged that the courses in electricity offered by the International Correspondence Schools are the best, most complete and most practical home-study courses offered to-day. The lessons are easy to learn, easy to remember and easy to apply because they were prepared by practical men, including—

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J. LESTER WOODBRIDGE, B.S. and M.E.
Chief Engineer, The Electric Storage Battery Company.

O. J. BUSHNELL
Superintendent, Meter Department, Commonwealth Edison Company.

S. A. FLETCHER, B.S.
Electrical Engineer, Alabama Power Company.

H. B. GEAR, A.B. and M.C.
Engineer of Distribution, Commonwealth Edison Company.

C. E. KNOX
Consulting Electrical Engineer.

E. C. PARHAM, M.E.
Electrical Engineer, General Electric Company.

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Designer of Alternating Current Motors and Generators, Allis-Chalmers Manufacturing Company.

The value of these courses is so well known that they are recommended by leading electrical authorities everywhere.

Dr. Charles P. Steinmetz, the late electrical wizard of the General Electric Company, said—

"I am familiar with the textbooks and methods of instruction used by the International Correspondence Schools in their course in Electrical Engineering, and I also know of a number of young men who have taken these courses with great benefit. I believe that any young man who is interested in electricity if he will apply himself to one of these courses will find it a practical and economical way to acquire a knowledge of the profession."

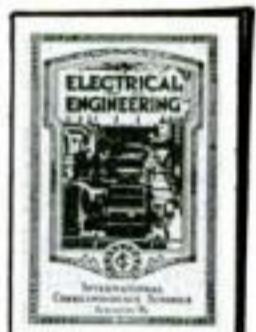
The indorsement of a man like Steinmetz means a great deal and should help you decide on the best school for men who want to advance in this interesting work. As a matter of fact, many of the leading electrical men of

to-day were once students of the International Correspondence Schools. There is a good job waiting for you if you will only make the start.

Write for this Free Booklet

It describes the I. C. S. Courses in Electrical Engineering, Electric Lighting, Electric Wiring, Radio and scores of other electrical subjects. Tells how other men have succeeded and why. 64 pages. An interesting instructive booklet that you will want to read from cover to cover. Sent free on request.

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Bx 7620-D, Scranton, Penna.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

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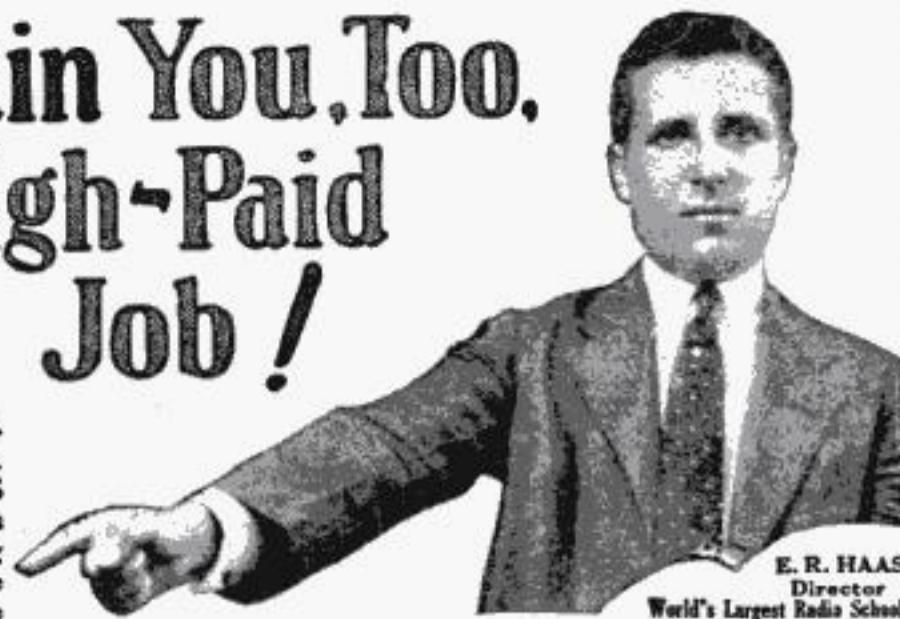
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* * *

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* * *

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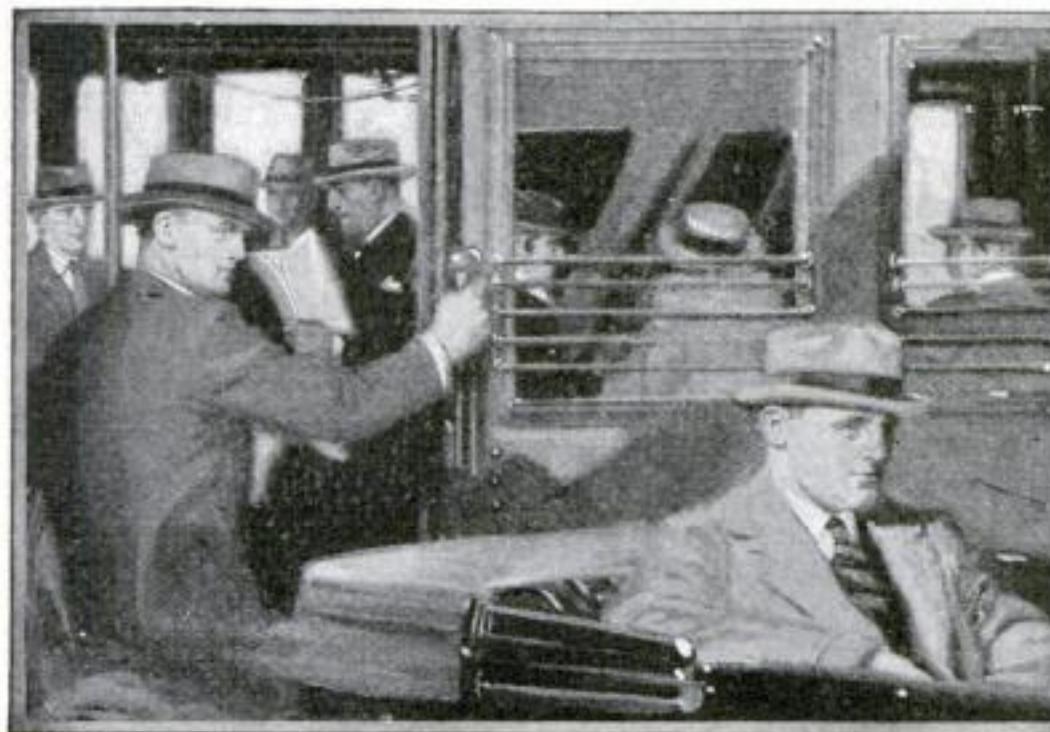
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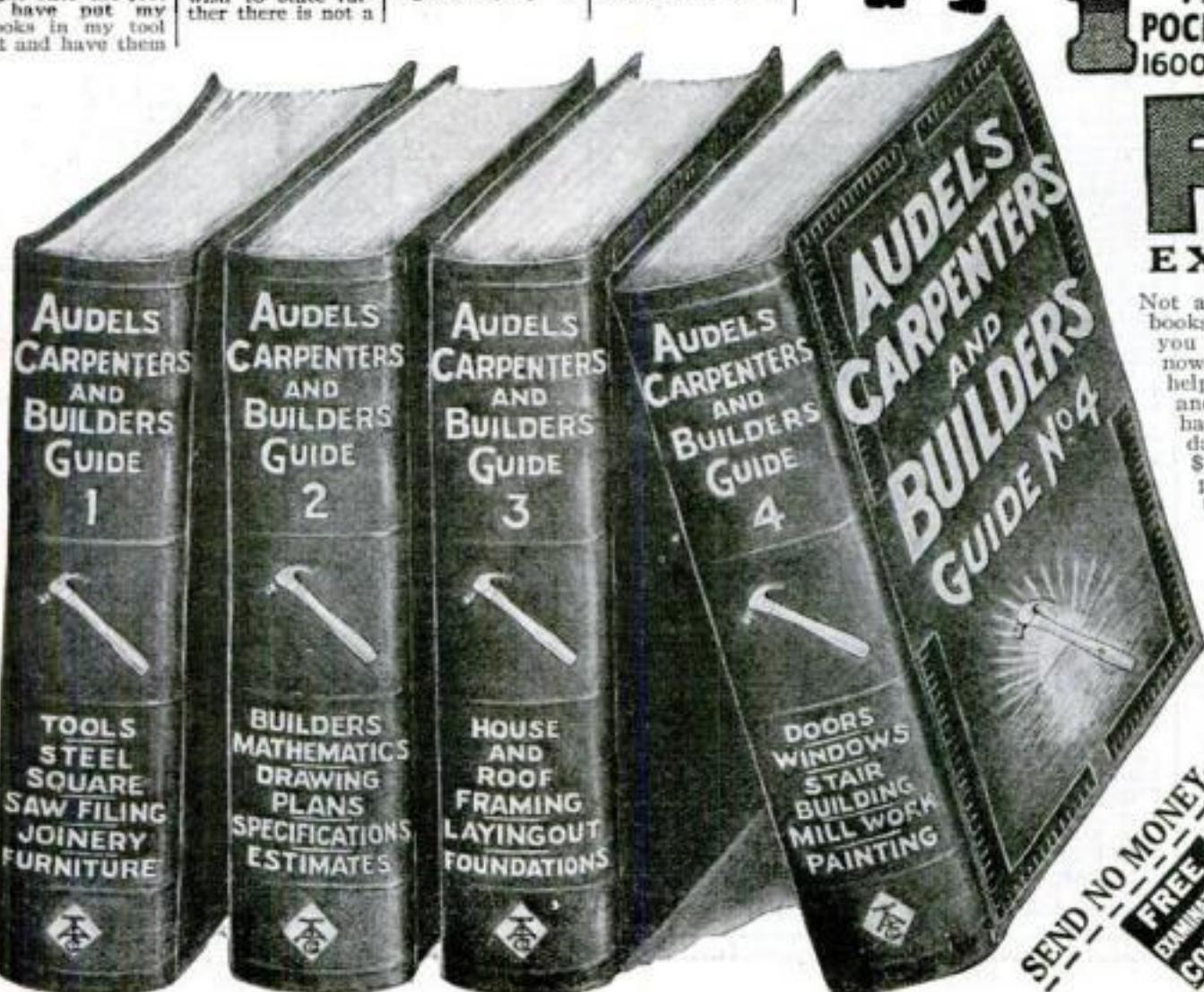
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EVERY Ford owner in the world wants this! The Hamer Visible Vaporizer guarantees increased mileage (3 to 8 miles per gallon), more power (40% and better), quicker pickup, no carbon, smooth running motor, less heat, longer life, more driving comfort. Sells \$4.50; your commission, \$3. Exclusive territory. Details and proofs. Visible Vaporizer, Dept. 17, Chamberlain, S. D.

\$10 DAILY silvering mirrors, plating and refinishing lamps, reflectors, autos, beds, chandeliers by new method. Outfits furnished. Write Gunmetal Co., Ave. F, Deaderick, Illinois.

AGENTS—Write for free samples. Sell Madison "Better-Made" Shirts for large Manufacturer direct to wearer. No capital or experience required. Many earn \$100 weekly and bonus. Madison Mills, 564 Broadway, New York.

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WONDERFUL discovery. Charges batteries in ten minutes. Gallon free to agents. Radiolite Co., St. Paul, Minn.

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**More Money Making Opportunities
on Pages 6 to 24**

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The Secret that Tripled My Sales

How I stepped into the big-money class, just as soon as I woke up and learned the true principles of quick and easy selling

By Roger Farrer



Photograph by Bachrach

WAKE up, Roger!"

The sharp command aroused me from a comfortable nap I was taking in a club car on the Sante Fe.

It was Bill Burdick who had called me, and who dropped into the seat beside me.

Bill is the star salesman of the Everitt-Seaman Company, and is said to be cleaning up about \$18,000 a year.

I have always admired and envied Bill. He took life so easily. He never seemed to be hurried or worried, nor to work half as hard as I did, but he earned *three times as much money*. It was a mystery to me. I couldn't fathom it at all.

Bill is not particularly well-educated. He certainly is not brilliant nor good looking, nor is he an especially careful dresser. Yet he seems to make a hit everywhere. At least he gets the business, earns big money, and has the respect and confidence of all who know him, and those are the things that count.

This was the first time I had had a chance to have a good talk with Bill for more than a year, and I took advantage of it to discover the secret of his success as a salesman.

I had rather expected to hear a long sermon on study, application, persistence, experience, etc. But no, Bill had no sermon to deliver. He told me how, after plugging along for years by haphazard, hit-or-miss, rule-of-thumb methods, he ran across the Mackintosh System of Selling—a system that gave him the simple fundamental secrets of success.

Bill had a copy of the System with him, which he gave me. I began reading it at once, and it was a revelation to me. The simplicity—the power—the practicality—of the Mackintosh System really dazzled me. It seemed too simple—and too good—to be true. But I made up my mind that I would discard every selling idea I was using, every plan and knack of getting orders I was then following, and would give the Mackintosh System a thorough try-out.

I studied the System very carefully over

that week-end, and I started out the following Monday morning to put my new-found knowledge to the test. To say that I was astounded at the results is putting it mildly. I booked orders with an ease that really startled me. It seemed like a trick. I pinched myself to be sure that I was really awake and selling the same old line of goods.

Then, doubt getting the better of me, I said: "I guess I am fooling myself. What's happened is that I have struck a lot of people this week that any dub could sell." But sales kept up the next week—and the next—and the next.

The System worked! And it worked with increasing effectiveness as I learned more and more how to use it. And now I am doing *three times* the business I was before Bill Burdick woke me up on the train, and I don't feel that I am working nearly so hard.

Now I don't see any reason on earth why every reader of this magazine, who is trying to sell anything—merchandise or only personal services—should not profit by the Mackintosh System of Selling, just as I have done. It costs very little to secure this System and it can be learned in a few hours time.

I firmly believe that Mackintosh has worked out the big, important, bed-rock principles of selling. And I believe that failure to recognize and use these principles is the real reason why so many salesmen never get above making a mere living.

The Mackintosh System should be in the hands of everyone who has anything to sell. And, when you stop to think of it, that means most all of us, for we are all salesmen. We are all trying to sell something to somebody, if it is only ourselves—our services—our ideas—our personality.

Charles Henry Mackintosh, the author of this successful system of selling, is himself one of the world's star salesmen. For a number of years he was Sales and Advertising Counselor of LaSalle Extension University. He is now an independent Sales and Advertising Counselor in Chicago, and has as clients many leading business houses throughout the entire country. He has been honored with the presidency of the Associated Advertising Clubs of the World.

In one year he traveled 47,886 miles and delivered addresses on Advertising and Selling before 273 clubs, conventions, colleges, high-schools, etc. His work has inspired over half a million lines of newspaper publicity from Maine to California.

Here are a few brief comments about this remarkable man:

"Mr. Mackintosh is recognized as one of the foremost business experts of the world."—*Portland Oregonian*. "The highest authority on advertising and selling in the country."—*Grand Rapids Herald*. "He is an expert in salesmanship."—*Appleton (Wis.) Post*. "Mackintosh delivered one of the best rapid fire business talks ever heard in Topeka."—*Topeka (Kan.) Journal*. "Forceful argument for education of sales people."—*Three Rivers (Mich.) Commercial*. "Mackintosh is one of the leading exponents of modern salesmanship in America."—*Portland (Ore.) Telegram*.

Read these extracts from letters by prominent business men:

"You will be interested to know that four of our leading manufacturing concerns have revolutionized their sales methods because of the counsel received from you."—*William Brockhausen, President Advertising Club, San Antonio, Tex.* "Mackintosh

has done much work for my companies, and his work and talents have been satisfactory to the highest degree."—*A. W. Hartman, President Duluth Edison Electric Co., Duluth, Minn.* "I was so much interested in your speech at the New England Conference that I wonder whether you have written anything on the subject which you handled in such a masterly fashion. Can you tell me where I may be able to acquire some of the matter with which you are so thoroughly familiar?"—*S. R. Latshaw, Advertising Director, The Butterick Publishing Co., New York*. "Not less than four or five managers of our largest establishments stated that if they had known the character of your talk they would have had all their department managers present and as many of their salespeople as possible."—*G. W. Preston, President Advertising Club, Cincinnati, Ohio*.

No matter what you have to sell, if it is only your own services, you should get and examine the Mackintosh System of Selling, at once. Unlike many things you have probably read, it is not a mass of theories and speculations. It is plain, down-to-the-earth logic. It is common-sense brass-tacks from start to finish.

Like all other sciences, selling is based on fundamental laws which govern it. Ignorance of these laws is the reason so many salesmen fail to "bring home the bacon."

So, no matter what you are selling—even if you are selling only your services as stenographer, bookkeeper, clerk or what-not—you need the Mackintosh System to guide you. It is not only valuable in selling merchandise. It will show you how to sell *yourself*—your services—for the highest possible market price. No matter what you have to sell the Mackintosh System applies.

But you do not need to take my word for this. You can investigate and judge for yourself. Do not send any money. Simply sign and mail the coupon, and the complete Mackintosh System of Selling will be sent to you at once, all charges prepaid. Then examine the System and see for yourself just what it can do for you. Then if you do not feel it is one of the best things you ever got hold of, simply remail it.

On the other hand, if you are as delighted with it as are other men and women who have profited by this great secret of selling, send only \$3 in full payment.

Be prompt. Act now. If you want to sell your goods or your services to the best possible advantage, you cannot afford to turn this page without arranging to at least examine this marvelous System of Selling.

Therefore, because of its great importance—because there is no risk—because you have so much to gain—because you cannot possibly lose—mail the coupon now—before you turn this page—before you forget. Let the Mackintosh System of Selling show you how to *double* and *triple* your selling ability. American Business Builders, Dept. M-3411, 1133 Broadway, New York.

American Business Builders, Dept. M-3411
1133 Broadway, New York City

I am always on the lookout for anything that will increase my selling ability and I would like to look over the Mackintosh System of Selling. Send it to me at once. If, after examination, I want to keep the System, I will send you \$3 in full payment. Otherwise I will remail it to you within five days and owe you nothing.

Name.....

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LEARNING music is no longer a difficult task. If you can read the alphabet, you can now quickly learn to play your favorite instrument! A delightful new method has made it positively easy to become a capable performer within just a few months. And the cost is only a **fraction** of what people used to spend on the old, slow methods!

You don't need a private teacher, this new way. You study entirely at home, in the privacy of your own room, with no one to interrupt or embarrass you. And, strange as it may seem, you'll enjoy every minute of it—because the new method is **agreeable** as well as **rapid**!

No Tricks or Stunts—You Learn from "Regular" Music

You don't have to know the first thing about music in order to begin. You learn to play from actual notes, just like the best musicians do. And almost before you realize your progress, you begin playing real tunes and melodies instead of just scales. There are no trick "numbers," no "memory stunts." When you finish the U. S. School of Music course, you can pick up any piece of regular printed music and understand it! You'll be able to read music, popular and classic, and play it from the notes. You'll acquire a lifelong ability to please your friends, amuse yourself, and, if you like, make money (musicians are highly paid for their pleasant work).

Whether you like the piano, violin, 'cello, organ, saxophone, or any other instrument, you can now learn to play it in an amazingly short time. By means of the newly perfected print-and-picture method reading and playing music is made almost as simple as reading aloud from a book. You simply can't go wrong. First, you are told how a thing is done, then a picture shows you how, then you do it yourself and hear it. No private teacher could make it any clearer. The lessons come to you by mail at regular intervals. They consist of complete printed instructions, diagrams, all the music you need, and music paper for writing out test exercises. And if anything comes up which is not **entirely plain**, you can write to your instructor and get a full, prompt, personal reply!



The Surest Way To Be Popular and Have a Good Time

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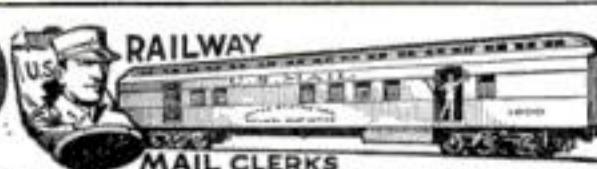
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Money Making Opportunities

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BRUSH Sales Managers. Both you and your salesmen can make unusual profits selling our standard quality wire-twisted brushes and mops. Write Cleveland Brush & Mop Co., Specialty Dept. B, 8109 Townsend Ave., Cleveland, Ohio.

SALESMAN earn \$15 to \$20 daily selling Manchester Twill garments made to measure, \$12.50. Write for particulars. Chicago Utility Garment Corp., 1432 Altgeld St.

BIG money selling gold initials. Quick Sales. Every car owner buys. You charge \$1.50—Make \$1.44 every sale. Your profit \$20 Daily. No license. No experience. "Samples free." Nullife (P) Monogram Company, Hartford, Conn.

MAKE \$17 day—Finest extracts, food products, toilet preparations, household necessities. Credit: sample case free. Write for amazing offer. Perkins Products, B-26, Hastings, Nebr.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Ave., New York.

MAKE extra money. Xmas postal, folder, tag combination packs. 10th season. Sell 25¢. Sample 15¢. Big profits. Ulfert, 133 West 15th, New York.

BIG money and fast sales. Every owner buys gold initials for his auto. You charge \$1.50, make \$1.44. 10 orders daily easy. Information and samples free. World Monogram Co., Dept. 25, Newark, N. J.

ONLY one sale a day means \$200 per month! Five sales \$1,000 per month. Marvelous new adding machine. Retails \$15.00. Work equals \$350 machine. Adds, subtracts, multiplies, divides automatically Speedy, accurate, durable, handsome. Five year guarantee. Offices, stores, factories, garages buy one to dozen. A fortune for live agents. Write quick for protected territory and free trial offer. Lightning Calculator Co., Dept. P, Grand Rapids, Michigan.

SALESMEN, can make \$5.00 a day selling our calendars, pencils, signs, advertising novelties, yardsticks, whistles, etc. Liberal terms. Sells entire year. Fine side line. Local and traveling agencies. Model Calendar Co., Dept. 309, South Bend, Indiana.

INSTANT Weld—Repairs largest punctures without cement or heat. Lena's profit one day \$55. Write quick. Free sample. Territory going fast. Tourist's Pride Mfg. Co., Desk R, Minneapolis, Minnesota.

STAMPING names on emblem key checks. Sample 20¢. Key check outfit, steel dies, key cases, etc. Service Sales Corporation, Shelby, Ohio.

AGENTS—Clever Invention! Inkspoon makes every pen a fountain pen. Fast office seller, big profit, demand increasing everywhere. Exclusive territory offered. Sample free. H. Marui Company, Tribune Building, New York.

AGENTS—Best seller; Jem Rubber Repair for tires and tubes; supersedes vulcanization at a saving of over 800 per cent; put it on cold, it vulcanizes itself in two minutes, and is guaranteed to last the life of the tire or tube; sells to every auto owner and accessory dealer. For particulars how to make big money and free sample, address Amazon Rubber Co., 504 Amazon Building, Philadelphia, Pennsylvania.

EVERY house a sale: Fast sellers; Particulars. Helmers Company, Desk No. 12, Hoboken, N. J.

31 BILLION, 650 million marks, real German currency for only \$1.00. Wholesale prices with order only. Atlantic Co., 1209 Beach Ave., Bronx, New York.

MAKE \$25 to \$50 week representing Clow's Famous Philadelphia Hosiery, direct from mill—for men, women, children. Every pair guaranteed. Prices that win. Free book "How to Start" tells the story. George Clow's Company, Desk 24, Philadelphia, Pennsylvania.

SELL beautiful \$7.00 red and black over-sized hand made Fountain Pens for \$3.50. Cost you \$1.75. With bonus \$1.55. Post card brings full details, or C. O. D. sample, at wholesale price. Johnson Pen Co., 117 South First St., Rockford, Ill. Dept. C.

SALESMEN wanted to sell our line of labels as side line. Commission. Patrick Label Co., 49F South Ave., Rochester, N. Y.

DUSTLESS Sponge Cloth, New Invention. (1) Rub—Dusts, Cleans and Polishes Automobiles, Furniture, Pictures, Pianos. Retails 50¢—Costs 16¢. Sample Free. Nullife Sponge, Hartford, Conn.

WE start you without a dollar. Soaps, extracts, perfumes, toilet goods. Experience unnecessary. Carnation Co., Dept. 21, St. Louis.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Ave., New York.

AGENTS—Steady income. Large manufacturer of handkerchiefs and dress goods, etc., wishes representative in each locality. Factory to consumer. Big profits honest goods. Credit given. Send for particulars Freeport Mfg. Co., 24 Main St., Brooklyn, N. Y.

AGENTS wanted. \$60-\$200 a week. Genuine Gold Letters for store windows. Easily applied. Free Samples. Liberal offer to general agents. Metallic Letter Co., 434A, North Clark, Chicago.

AGENTS—Make a dollar an hour. Sell Mendets, a patent patch for instantly mending leaks in all utensils. Sample package free. Collette Mfg. Co., Dept. 467, Amsterdam, N. Y.

More Money Making Opportunities
on pages 6 to 24

Men Past 40 Find Simple New Gland Treatment Ahead of Medicine or Surgery

During the Last Seven Years a Series of Valuable Experiments Have Been Conducted in the Middle West. The Treatment Developed Has Proved Astoundingly Beneficial in the Relief of Certain Painful Conditions Common to Men Approaching or Past the Prime of Life

By Byram C. Kelley, A.M., LL.D.

ACCORDING to medical authorities, 65% of all men past a certain middle age suffer from a disorder of the prostate gland that has a depressing—and often painful—effect on the entire body.

Some of them recognize the real cause, and resort to surgery or elaborate, expensive treatment that is sometimes beneficial, sometimes ineffective. Others blame their troubles on approaching age and despairingly resign themselves to the disagreeable symptoms, not knowing how to obtain relief.

What Are the Symptoms?

In prostate trouble the system may seem to have slowed up. One's mental and physical grasp have both lessened. The memory may become treacherous. Physical efforts once easy, now often leave one panting and exhausted. Nervousness, restlessness and insomnia frequently appear. Often the blood pressure increases to a dangerous degree. Sciatica, weak back, lack of vigor and chronic constipation are frequent symptoms. There is often a great deal of pain in the neighborhood of the prostate gland and through the loins and lower back. One of the most disagreeable features of such troubles—the feature

most often apparent—is the necessity for frequent nightly risings which seem to betoken weakness of kidneys and bladder.

10,000 Find Relief

More than 10,000 men have already used the treatment which has been developed and perfected during the last seven years. It usually banishes those troubles often blamed on approaching age, because it tones and invigorates the important prostate gland—the keystone of the entire gland system. Then it not only banishes many painful symptoms felt in the neighborhood of the prostate gland itself—thus it also tends to tone up or assist the entire glandular system, helping to re-invigorate every great organ and every bodily function.

It has brought results where every other method has apparently failed. It has brought new vigor in cases where the surgeon's knife seemed the only remaining course and it has brought relief to a degree that could not be hoped for from an operation.

Every man past 40—in fact every man in his late thirties—should learn about this method—by which he can treat himself at home—the way in which he should find quick, inexpensive, safe and permanent relief, or pay nothing.



Doctor Obtains Remarkable Relief from Prostate Trouble

"I was a nervous wreck. I had enlarged prostate gland and had to be up ten to fifteen times at night. I had spent hundreds of dollars trying to get relief. Then I began using your treatment according to directions. In about two months I was greatly relieved. I feel that the trouble is entirely relieved as I have not felt the need of treatment in the last three months. I recommended it to two of my friends who have used it with good results."—Dr. J. Frank McMichael, Union City, Tenn.



Although two-thirds of all men past a certain age have prostate gland trouble, many do not realize the real cause of their painful or inconvenient symptoms or their "slowing up." The article herewith treats of this subject in an understandable manner and points the way to speedy relief.

Why Many Men Are Old at 40

Above is the title of a book written by a member of the American Association for Advancement of Science. He is the discoverer of this great, new hygienic method and has been actively engaged, with other scientists, in the experiments made during the last seven years.

This book gives you much clear explanation about the cause and result of prostate disorder. It makes it possible for you to ask yourself certain questions that should enable you to tell whether or not you are subject to this trouble which results in such a loss of tone, health and capacity to enjoy life. And it discloses this excellent means for treatment.

FREE—Discoverer's Book

The blank below brings you this book. It will be mailed in plain cover without any obligation at all on your part. Simply fill it out promptly and mail today before the present edition is exhausted. If you wish specific information, mention age, occupation, symptoms and how long you have been troubled.

The Electro Thermal Company
4039 Main Street, Steubenville, Ohio
FREE INFORMATION BLANK

THE ELECTRO THERMAL COMPANY
4039 Main Street, Steubenville, Ohio.

Please send me at once your booklet, "Why Many Men Are Old at 40," and full details about the new Hygiene and Therapy.

Name.....

Address.....

City..... State.....
This Therapy is not concerned with Violet Ray, Phonograph Records, Electric Treatment, Diets, or Course of Instruction.
Western Office, Dept. 40D, Los Angeles, Calif.



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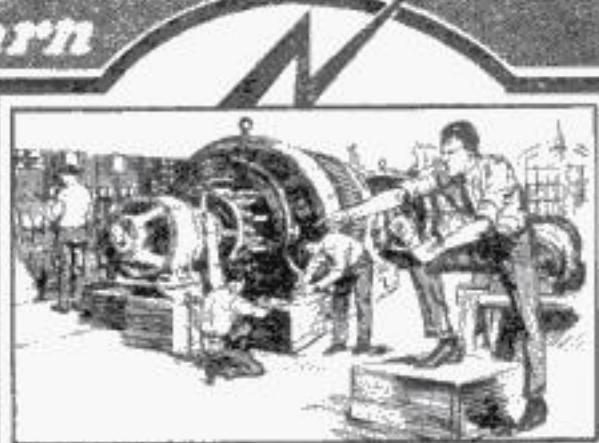
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- and Electrical Engineers of the following Universities:
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 4. Lehigh University
 5. University of Vermont
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I enclose a photograph of myself and the switchboard of the 10,000 K. V. A. hydroelectric plant where I am employed.

My ability to hold this position is due entirely to the training I have received from the American School, as when I first enrolled with you I was a common laborer and decimals were a total mystery to me. Now, however, I regularly use logarithms to find the daily load factor of this plant.

GUY VICKERS,
Wendell, Idaho.

CHIEF ENGINEER DUNLAP, Electrical Division
AMERICAN SCHOOL
Dept. E-875, Drexel Ave. and 58th, Chicago

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**This Book
FREE!**



There may be a fortune for you in this FREE book about Inventions

Invention is the easiest way to earn a fortune. Little ideas have made millions of dollars for their inventors. This wonderful book explains how fifteen famous inventors now teach you the secrets of successful invention in your own home.

HOW would you like to be the inventor of the Gillette Safety Razor, who makes TWO AND ONE-HALF MILLION DOLLARS a year? Wouldn't you gladly be the inventor of the snap fastener whose profits were so big that he paid an income tax of \$29,000? Wouldn't you willingly change places with the inventor of the President Suspenders who is now worth \$5,000,000, or the inventor of the Autographic attachment for cameras who sold his patents for \$300,000?

One single idea—as simple as any of these—can make you independently wealthy in a short time. Other inventors have made thousands of dollars from such common things as the crimped hair-pin, the metal tip shoelaces, the paper safety match, the ordinary wire paper clip. These are certainly not complicated inventions—they are so simple, in fact, that probably thousands of people thought of them but only one man DID anything about the idea when it came to him.

Ideas Worth Fortunes

Every day you find ideas for new inventions. It may be a new toy for your children. The man who invented the Kiddie-Kar, it is reported, made over \$5,000,000. It may be a new kind of soap. B. T. Babbitt is worth millions of dollars today. It can even be a new kind of broom to make housework easier for millions of housewives. But no matter what it is—if your idea is practical, if it solves a problem, if it satisfies a need—a fortune may be waiting for you.

Perhaps even now you have splendid ideas for inventions but the only reason you have not developed them is because you doubt your own ability to invent. Or, like most persons, you believe that you were not born to be an inventor; that inventors are men who invent things as

naturally as other people work as bookkeepers, mechanics, doctors or farmers.

Proof YOU Can Invent

As a matter of fact inventors themselves say that invention is based upon exact laws which anyone can learn. It is merely a matter of first *seeing* something to be fixed and then of *thinking* of some principle which will fix it. That is all—that is *everything* to invention. Brought down to its plainest definition, invention is merely the science of "fixing things."

And how many times a day you "fix things." A leaky faucet, a rattling window, a wobbly table—you fix hundreds of things like these every year. And, though you may never have realized it, every time you "fix things," you use the very definite exact principles which are the basis of Inventive Science.

What Edison Says

Could you ask the advice of any greater authority than Thomas A. Edison? He says: "*Invention is a Science and should be taught as a profession.*"

And now, for the first time, you can actually learn invention as a profession—exactly as other people are learning electricity, mechanics, law, medicine.

The Bureau of Inventive Science offers you the first course in practical invention ever devised. It has written down the easy-to-learn principles of Inventive Science so that everybody can read them and learn to use them. It doesn't matter who you are, or what your present work is. With no special knowledge of mechanics or science you can learn how to invent!

All you need to become successful is this easy, fascinating training which will develop your ability so it will be worth real money. Fifteen famous inventors tell you the secrets of invention, which every successful inventor knows.

- 15 great inventors teach you every step in inventive science.
- How to develop your imagination
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- How to organize a company
- How to protect your rights
- How to market a patent
- and hundreds of other vitally important facts which EVERY successful inventor knows and uses.

They explain how to originate ideas, how to develop and perfect them, how to get patents. But they tell even more: Thousands of inexperienced inventors have been defrauded of their rewards because they did not know how to protect their patent rights. This great course tells you everything you want to know—how to sell your invention, how to get royalties—how to get the most money for your ideas.

New FREE Book

The most interesting part of this wonderful course is that it teaches invention by actual practice right in your own home. With each lesson you are sent one practical, absorbing exercise in solving actual inventive problems—which gives you an unforgettable, instinctive habit of thinking inventively—worth more than you realize. In fact, the lessons and exercises are so simple, so easy to understand, so interesting that they seem more like a pleasant game than like instruction which can make you a successful inventor.

A wonderful new book, just printed, tells you more about the Bureau of Inventive Science and its simple new course in invention. It costs nothing, so send the coupon at once. This bureau is not connected with patent attorneys or manufacturers. Its only purpose is to teach you the principles of practical invention used by every successful inventor. Write for the FREE BOOK now. It may show you the way to make a fortune.

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\$2500 REWARD For the Capture of An Unknown Man

TWICE he had entered the St. Clair Mansion. What was he after? Who? What was in danger?

Berteau, the famous detective, had warned St. Clair that the mysterious marauder would come again. And now—a noise in the passage! The creak of an opening door. A shot in the dark! A capture!

Is this wounded stranger the mysterious intruder? Who could tell? Yet Berteau identified the man without hesitation and won the \$2500 reward.

How did he do it? Easy enough for the Finger Print Expert. He is the specialist, the leader, the cream of detectives. Every day's paper tells of their wonderful exploits in solving mysterious crimes and convicting dangerous criminals.

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The demand for trained men by governments, states, cities, detective agencies, corporations, and private bureaus is becoming greater every day. Here is a real opportunity for YOU. Can you imagine a more fascinating line of work than this? Often life and death depend on finger print evidence—and big rewards go to the expert. Many experts earn regularly from \$3,000 to \$10,000 per year.

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And now you can learn the secrets of this science at home in your spare time. Any man with common school education and average ability can become a Finger Print Detective in surprisingly short time.

Free Course in Secret Service

For a limited time we are making a special offer of a *Professional Finger Print Outfit, absolutely Free, and Free Course in Secret Service Intelligence*. Mastery of these two kindred professions will open a brilliant career for you.

Write quickly for fully illustrated free book on Finger Prints which explains this wonderful training in detail. Don't wait until this offer has expired—mail the coupon now. You may never see this announcement again! You assume no obligation—you have everything to gain and nothing to lose. Write at once—address

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AGENTS Wanted—Something New—Fire fighter sells easily. Makes a spectacular demonstration; car owners, homes, factories, stores, practically buy on sight. Our men make \$10.00 to \$50.00 a day. If you wish to establish a business of your own with unlimited possibilities for making big money, write us today. Fyr-Fyter Co., 298 Fyr-Fyter Bldg., Dayton, Ohio.

SELLS at sight. Prints merchant's ad on wrapping paper, sacks, blotters, boxes, etc. Full time or side-line salesmen wanted. Automatic Ad-Stamper Manufacturing Company, Joplin, Mo.

\$20 PROFIT daily selling needlebooks; cost 3c-5c each; sells 25c; value 50c. Three samples 25c. Catalogue Free. Needlebook Specialty Co., 661 Broadway, New York.

SELLS itself. \$1000.00 Home Protection Contract. \$40 to \$80 for live wires daily. Write Am. Nat'l Benefit Corporation, Peoria, Ill.

EVERYBODY uses extracts. Sell Duo Double strength Extracts. Complete line household necessities. Big repeaters. Write today. Duo Co., Dept. E66, Attica N. Y.

WANTED—To bear from good stock salesman, stock insured against loss; good commission. T. G. Sortor, St. Joseph, Mo.

CAN you sell Ford size tires at \$3.50 each? Write for plan. Details free. American Accessories Co., Dept. 179, Cincinnati, Ohio.

YOU can make \$100 a week selling our new specialties: Ivoryplak and Lykoi Paintings, also complete line of photo novelties. 600% profit. Marvelous opportunity. Experience unnecessary. Perry Photo Novelty Corp., Sec. PS-11, 360 Bowery, New York.

AGENTS—\$15 a day—Easy, quick Sales—Free Auto—Big weekly Bonus—\$1.50 premium Free to every customer. Simply show our Beautiful, 7 piece, Solid Aluminum Handle Cutlery Set. Appeals instantly. We deliver and collect. Pay daily. New Era Mfg. Co., 803 Madison St., Dept. 41-A, Chicago.

AGENTS make \$100 a week placing advertising cigar lighters with glass front. Every dealer wants one. Average profit \$25. Write for free plan. Drake Mfg. Co., Dept. P., Milwaukee, Wis.

BRING Home the Bi-con—selling Stuart's Stain Remover. Removes ink, iron rust, grass and fruit stains. Write for free samples and terms today. C. H. Stuart & Co., 5968 B'way, Newark, New York.

ARE you old at forty? See our advertisement on page 17 of this issue. The Electro Thermal Company, 4039 Main St., Steubenville, Ohio.

NEW office specialty. Minute demonstration, sure sale. 100% repeater. Odiorne, 117 South Fourth, Philadelphia.

MARVELOUS Miniature X-Ray shows bones in fingers, lead in pencil, etc. Wonderful seller. Simply show it, everybody buys. Immense profit. Particulars free; sample ten cents. Rialto 1012B Fitzgerald Bldg., New York.

EXCLUSIVE State Distributor. \$20,000 yearly. Newly invented pricing system, retails \$4.90. Tremendous demand! Big repeats. Millen Mfg. Dept. GH, Colonial Bldg., Boston, Massachusetts.

MAKE \$100 weekly in spare time. Sell what the public wants—long distance radio receiving sets. Two sales weekly pays \$100 profit. No big investment, no canvassing. Sharpe of Colorado made \$855 in one month. Representatives wanted at once. This plan is sweeping the country—write today before your county is gone. Ozarka, 803 Washington Blvd., Chicago.

SELL the liveliest, quickest selling specialties ever known. Famous "Hahway" self-lighting pocket cigar lighters and gas lighters. Low prices. Easily demonstrated. Sell to dealers. Employ sub agents. Exclusive territory. Make over 100% profit. S. Pernhardt, 148 Chambers Street, New York.

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EARN money weekly, spare time, home, addressing mailing, music, circulars. Send 10c for music information. New England Music Co., 118 Asylum St., Dept. S-14, Hartford, Conn.

MONEY! Silvering Mirrors, Auto Lights, Radiators, tableware. Methods Free. Write Sprinkle, Plater, 98, Marion, Indiana.

SILVERING Mirrors, French plate. Easily learned; immense profits. Plans free. Wear Mirror Works, Excelsior Springs, Mo.

OUR genuine gold window sign letters are an excellent money-making proposition for handy men. Stann Sign System, East Bethune Avenue, Detroit, Michigan.

MR. BRUSH SALESMEN: Old established New York Brush Manufacturers require the services of men in all territories to sell their extensive line of Sanitary Twisted in wire brushes. We pay larger commissions than any other brush house in the country. Write immediately for proposition. Wire Grip Sanitary Brush Corp., 15 Mercer St., New York.

ARE you old at forty? See our advertisement on page 17 of this issue. The Electro Thermal Company, 4039 Main St., Steubenville, Ohio.

EMPLOYMENT in South America. We furnish classified addresses of 388 employers in Peru, Bolivia and Argentine for \$1. South America Information Bureau, Portland, Ore.

MONEY Polychroming, also Silvering Mirrors. Sample and particulars free. Polychrome Works, 2604 East 40th, Kansas City, Mo.

EARN \$1.20 an hour cutting blanks at home; spare time. Men only. Send addressed reply envelope. Good-year Sm., 147 W. 23rd St., New York.

WANTED—Representatives in every factory in the United States. Popular Science Monthly, 250 Fourth Ave., New York.

MEN to Build Radio Sets for me in spare time. Leon Lambert, 555-D Kaufman Bldg., Wichita, Kansas.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Ave., New York.

**More Money Making Opportunities
on pages 6 to 24**

LEARN Electricity



Student winding a Stator in
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COYNE

Earn \$200 to \$800 a month! New Enlarged Course

I train you on everything from door-bells to power-plants—everything to make you a \$50 to \$200 a week EXPERT. You get complete PRACTICAL training in Circuits, House Wiring, D. C., A. C., Armature and Stator Winding, Drafting, Auto, Truck and Tractor Electricity, Battery Building and Repairing, and Radio. Everything to make you a thoroughly trained, BIG PAY, Electrical EXPERT

CHICAGO The Electrical Center of the World

The whole world of electricity is open to the COYNE trained Electrical Expert. Come to Chicago—the Electrical Center of the World. I pay your fare. Get your training at COYNE—the oldest, largest and best school of practical electricity in the country—endorsed by Electrical Industry. I do not offer a number of individual courses—I give you just one complete course so that you will be an Electrical Expert capable of commanding big pay. You can become an Expert and get big money in ANY branch of electricity if you come to COYNE.

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No books or useless theory. I train you on the greatest outfit of electrical apparatus of any institution in the country. I give you FREE complete Radio and Automotive courses. I also give you FREE a life Membership which enables you to stay longer if you want or to come back at any time and take up any new work which is constantly being installed to keep my school the most modern at all times.

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I help students to secure jobs to earn a good part of their living expenses while studying.

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Don't delay a minute—send that coupon right now for my big free catalog and full particulars of special offer. ACT NOW!

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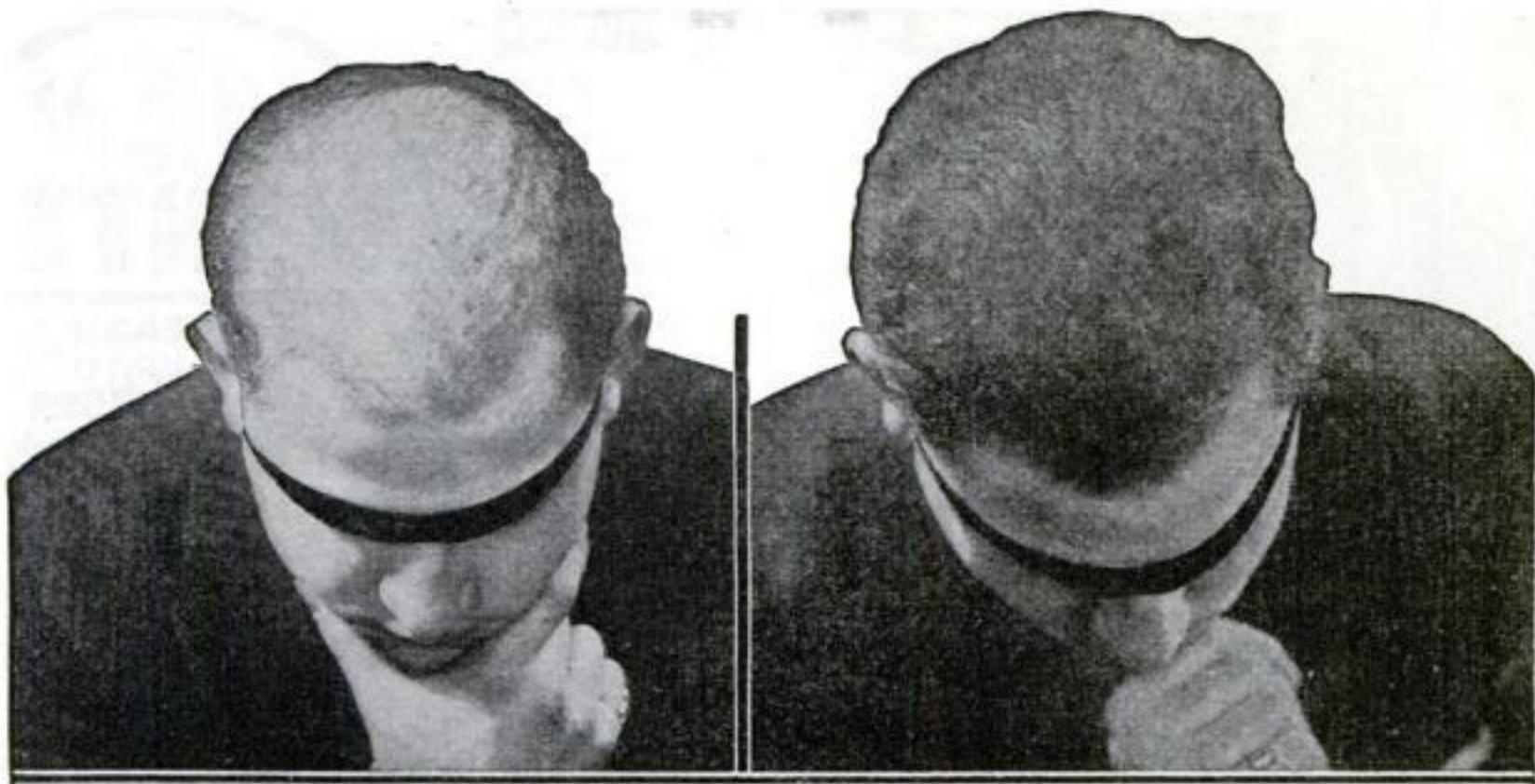
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1300-1310 W. Harrison St., Chicago

Mr. H. C. LEWIS, Pres. Dear Sir:—Please send me free your big new catalog and full particulars on free railroad fare offer and two free courses.

Name.....

Address.....



Here's Positive Proof That I Can Grow New Hair

These are true, unretouched photographs showing Mr. Murray Sandow's hair before—and 60 days after using my remarkable new treatment for baldness and falling hair. This is not a rare instance. Many others report equally astonishing results. To try my new discovery you need not risk a cent. For I positively *guarantee* results or charge you nothing. Mail coupon below for booklet describing my treatment and 30 Day Trial offer in detail.

By ALOIS MERKE

Founder of Merke Institute, Fifth Ave., N. Y.



FOR many months you have seen announcements concerning my new treatment for baldness and falling hair. If you are bald and have tried other treatments without results then naturally you are skeptical. All right, I don't blame you.

But what better PROOF is there that I can *actually grow new hair* than these two photographs reproduced above. They illustrate a result that hundreds of others have written us they too have secured through use of my marvelous discovery. In this particular case, Mr. Murray Sandow, of New York City, started my treatment January 23, 1924—and sixty days later—as you can see—he had an almost entirely new growth of hair.

Entirely New Method

My invention involves the application of new principles in stimulating hair growth. It proves that in many cases of baldness—the hair roots are not *dead*—but merely *dormant*. The reason tonics and other treatments fail to grow new hair is because they do not *reach* these *dormant hair roots*, but instead simply treat the *surface* of the scalp.

To make a tree grow you could not rub "growing fluid" on the bark. Instead you would get right to the roots. And so it is with the hair.

No Excuse for Most Baldness

At the Merke Institute on Fifth Avenue, New York, I've treated scores of prominent stage and social

celebrities—some paying as high as \$500 for the results my methods produced. Yet now by means of The Merke Thermocap Treatment, adapting the same principles to home use—thousands of men and women everywhere are securing the desired results—right in any home where there is electricity—and for just a few cents a day!

I don't say my treatment will grow hair in every case. There are some cases that nothing in the world can help. But since so many others have regained hair this way, isn't it worth a trial—especially since you do not risk a penny? For at the end of a month if you are not more than delighted with the growth of hair produced, you won't be out a cent. That's my absolute *Guarantee*. AND YOU ARE THE SOLE JUDGE.

Coupon Brings FREE Book

No matter how thin your hair may be—no matter how many methods you have tried without results, send at once for the 32-page book telling about this wonderful SCIENTIFIC TREATMENT. It gives scores of reports from others which indicate what this treatment will mean to you. Merely fill in and mail the coupon below and I will gladly send you the vitally interesting 32-page booklet giving full details about the famous Merke Thermocap Treatment. Clip and mail the coupon today. **Allied Merke Institutes, Inc., Dept. 1711, 512 Fifth Avenue, New York City.**

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Dept. 1711, 512 Fifth Avenue, New York City

Please send me, without cost or obligation on my part, the free copy of the new booklet describing in detail the Merke Thermocap treatment.

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(State whether Mr., Mrs., or Miss)

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City..... State.....



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MR. WILLIAMS called me into his office to-day and told me he was going to raise my salary \$50 a month.

"I am glad to give you this opportunity," he said, "for the best reason in the world. You deserve it."

"You may not know it, but I've been watching your work ever since the International Correspondence Schools wrote me that you had enrolled for a course of home study. Keep it up, young man, and you'll go far. I wish we had more men like you."

"And to think, Mary, I owe it all to you! I might still be drudging along in the same old job at the same old salary if you hadn't urged me to send in that I. C. S. coupon."

How about you? Are you always going to work for a small salary? Are you going to waste your natural ability all your life? Or are you going to get ahead in a big way? It all depends on what you do with your spare time.

More than 180,000 men are getting ready for promotion right now in the I. C. S. way. Let us tell you what we are doing for them and what we can do for you.

Mail the Coupon To-day

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Without cost or obligation on my part, please tell me how I can qualify for the position or in the subject before which I have marked an X:

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| <input type="checkbox"/> Traffic Management | <input type="checkbox"/> Show Card Lettering |
| <input type="checkbox"/> Business Law | <input type="checkbox"/> Stenography and Typing |
| <input type="checkbox"/> Banking and Banking Law | <input type="checkbox"/> Business English |
| <input type="checkbox"/> Accountancy (including C.P.A.) | <input type="checkbox"/> Civil Service |
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| <input type="checkbox"/> Bookkeeping | <input type="checkbox"/> Common School Subjects |
| <input type="checkbox"/> Private Secretary | <input type="checkbox"/> High School Subjects |
| <input type="checkbox"/> Spanish | <input type="checkbox"/> Illustrating |

TECHNICAL AND INDUSTRIAL COURSES

- | | |
|---|--|
| <input type="checkbox"/> Electrical Engineering | <input type="checkbox"/> Architect |
| <input type="checkbox"/> Electric Lighting | <input type="checkbox"/> Architects' Blue Prints |
| <input type="checkbox"/> Mechanical Engineer | <input type="checkbox"/> Contractor and Builder |
| <input type="checkbox"/> Mechanical Draftsman | <input type="checkbox"/> Architectural Draftsman |
| <input type="checkbox"/> Machine Shop Practice | <input type="checkbox"/> Concrete Builder |
| <input type="checkbox"/> Railroad Positions | <input type="checkbox"/> Structural Engineer |
| <input type="checkbox"/> Gas Engine Operating | <input type="checkbox"/> Chemistry <input type="checkbox"/> Pharmacy |
| <input type="checkbox"/> Civil Engineer | <input type="checkbox"/> Automobile Work |
| <input type="checkbox"/> Surveying and Mapping | <input type="checkbox"/> Airplane Engines |
| <input type="checkbox"/> Metallurgy <input type="checkbox"/> Mining | <input type="checkbox"/> Agriculture and Poultry |
| <input type="checkbox"/> Steam Engineering <input type="checkbox"/> Radio | <input type="checkbox"/> Mathematics |

Name _____ Street _____ Address _____ City _____ State _____

Occupation _____ Persons residing in Canada should send this coupon to the International Correspondence Schools Canadian, Limited, Montreal, Canada

3-6-24

Money Making Opportunities

DISTRICT MANAGERS AND REPRESENTATIVES WANTED

MONEY-Making opportunity selling Radiolite system of charging batteries. Sells to battery stations, garages, auto-owners. Write for information and free demonstration offer. Radiolite Co., Dept. L, St. Paul, Minn.

WORLD'S fastest selling auto accessory! County distributors wanted; write to-day. G. L. W., Spring Otter Co., San Diego, California.

WANTED—Representatives in every factory in the United States. Popular Science Monthly, 250 Fourth Ave., New York.

INCORPORATIONS

DELAWARE Incorporator. Charters: Fees Small; forms. Chas. G. Guyer, 901 Orange St., Wilmington, Delaware.

INCORPORATE Delaware. F. Lewis Mettler, 832 Market St., Wilmington, Del. (Established 1909.)

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Ave., New York.

BUSINESS OPPORTUNITIES

WE start you in business, furnishing everything; men and women, \$80.00 to \$100.00 weekly operating our "New System Specialty Candy Factories" anywhere. Opportunity lifetime; booklet free. W. Hillyer Ragsdale, Drawer 19, East Orange, N. J.

STOP plodding! Be successful. Operate a tire repair shop. Make big profits in any locality. We teach you and furnish complete equipments, \$100 up. Book of Opportunity free. Haywood's, 1306 South Oakley Avenue, Chicago.

FREE instruction book. Start Mail Order Business home evenings. Pier, 791 Cortlandt St., N. Y.

LEARN the collection business. Good income; quick results. Interesting booklet, "Skillful Collecting," free. National Collector's Association, Science Building, Newark, Ohio.

MEN, to sell regular \$1.00 and \$1.50 silk and knitted ties for 35c and 50c. Make \$15.00 daily. Write for particulars. American Cravat Exchange, 621 Broadway, New York.

BECOME a Foot Correctionist. A New Profession, not medical nor chiropody. All the trade you can attend to; many are making \$3000 to \$10,000 yearly, easy terms for training by mail; no further capital needed or goods to buy, no agency or soliciting. Address Stephenson Laboratory, 10 Back Bay, Boston, Mass.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to the Manager of Classified Advertising, Popular Science Monthly, 250 Fourth Ave., New York.

MECHANICS and Repair Shops—Get into a profitable business for yourself by establishing an Authorized Simplicity Cylinder Grinding Station, re-conditioning automobiles, trucks and tractors. Also become direct factory representative. \$600.00 investment required—installment plan. Be the first in your community to get our plan. Write Simplicity Mfg. Co., Port Washington, Wisconsin.

LET the "Bee" show you how to make big money easy. Copy with "Home-Life Magazine" only 10c. "Bee," 5309 Forest P., Kansas City, Mo.

INCH Display Advertisement 166 Magazines Thrice \$15. Year \$50. Wood's Popular Service, Atlantic City.

FOR \$10.00 we'll write three catchy classified order pulling advertisements that must bring you business. Rates of profitable magazines included. Mailing lists of mail order buyers, investors, agents, etc., at reasonable rates. Martinek Companies, Corona, N. Y.

MAKE money with your camera. (Lancaster), Box 436, Los Angeles.

THE Great Wheat Secret. New book showing the cause of wheat swings and how to forecast them. Unparalleled method for traders, speculators, millers. Eye-opening folder free; write today. Market Forecaster Co., Dept. B, Box 133, Kansas City, Mo.

USED Correspondence courses of all schools sold, rented and exchanged. List free. (Courses bought,) Lee Mountain, East Chattanooga, Tenn.

GO into business for yourself. Make money marketing proprietary specialties under your own labels. We furnish everything and show you how. Booklet free. National Scientific Laboratories, 224 Monroe, Richmond, Virginia.

EVERYBODY needs and buys the "Business Guide." Wells cleared \$1,150 in 35 days. Send for sample. It's Free. Nichols Co., Dept. 1B, Naperville, Ill.

WANTED—Representatives in every factory in the United States. Popular Science Monthly, 250 Fourth Ave., New York.

ARTIFICIAL Marble sanitary flooring instructions, ornamental casting, concrete, plaster, papier-mache decorations, garden furniture, statuary, rubber-moulds. 15 years instructing the public, particulars and 200 illustrations free. Chris Mahler, Huntington, N. Y.

150 MONEY Making Plans Free! Wolverine Bureau, PS-I, Muskegon, Michigan.

SUCCEED With Your Own Products—Formulas, Processes, Different, Dependable, Profitable. Catalog Free. C. Thaxby Co., Washington, D. C.

PATENTS Procured; Trade Marks Registered—A comprehensive, experienced, prompt service for the protection and development of your ideas. Preliminary advice gladly furnished without charge. Booklet of information and form for disclosing idea free on request. Richard B. Owen, 44 Owen Bldg., Washington, D.C., or 2276-Z Woolworth Bldg., New York.

START a paying business at home or small office anywhere. Solicting unnecessary. \$50.00 weekly easy. Begin in spare time. Free folder. Downs Co., 2326 Myrtle, St. Paul, Minnesota.

PUBLISH a Magazine of your own. We will tell you how. Very interesting, profitable. Information free. Lutz Printing Co., York, Pa.

FREE plan—start mail order business. H. J. Teeple, Decatur, Indiana.

More Money Making Opportunities
on pages 6 to 24

MEN WANTED

EARN UP TO \$125.00 per Week



WE TRAIN YOU AND START YOU EARNING

We want men to learn the Auto and Garage Business. Right now there are more calls for Greer Trained automobile men than we can supply. In 8 weeks we will make YOU an Auto or Garage expert and get you a job. You can be either an expert Auto, Truck or Tractor Repairman—Shop or Garage Manager—Salesman—Machine Shop Man—Battery Man—Tire Vulcanizer and Repair Man—Welder—Chauffeur—Electrician—anything you want to be in the Automobile, Garage or Accessory business. We train you and start you earning. Mail the coupon today for Free Book and Special Offer.

WE HELP YOU

Go In Business For Yourself

18 months ago one of our graduates started in business for himself with a capital of \$400. Today his business is worth \$30,000. Another graduate now averages \$400 to \$500 per month profit after 8 months in business. Another has retired—Independent at 40—his 8th year out of our shops. Out of more than 40,000 men we have trained, over 30,000 are now in business for themselves. You, too, can do what these men have done. Let us train you and help you get started in business for yourself. You can at least double your present earnings.

EARN WHILE YOU LEARN

We offer you a chance to earn while you learn. Our FREE EMPLOYMENT DEPARTMENT has secured thousands of part time jobs for men who have learned the Auto Business in the big Greer Shops. This is a wonderful opportunity for you. See it and seize it. Mail the coupon to me today for complete offer.

Railroad Fare Paid To Chicago

Here's your chance to come to Chicago—the great Auto Sales, Garage and Shop center. Over 40 Sales Agencies near the big Greer Shops. Hundreds more throughout the city. Over 5000 garages and repair shops. I allow railroad fare to Chicago and find you a home. The coupon brings complete offer.

FREE

This big AUTO BOOK is FREE to those who mail the coupon below. Many pages and pictures on Automobiles and Shop Training. Get it to-day—and study my Big Special Offer.

Mail This Today

EDWIN GREER, President

Greer College of Automotive Engineering

2024 S. Wabash Ave., Dept. 2502, Chicago, Ill.

Please send me FREE Book, "How to Succeed in The Auto & Tractor Business," and Special Training Offer. This request does not obligate me in any way.

Name _____

Address _____

Master Electricity

by the Associated Electrical Engineers' Remarkable, New "Experience Method" and quickly prepare yourself for Electrical Jobs paying \$2,500, \$5,000 a year and up



Electricity is the fastest growing industry on earth. Thousands of trained men are needed to fill the NEW JOBS constantly opening—the most fascinating and highest paid work, and offering the biggest future. There is a

big-money job ready for you in Electricity just as soon as you are ready for it. The A. E. E. "Experience Method" will quickly prepare you for your big opportunity in Electricity right in your own home, in your spare time

The A. E. E. "Experience Method" is the Biggest and Most Revolutionary Advance in the History of Electrical Training

Under ordinary "school" methods, you first get your training and then have still to get your experience—a long, hard grind. The Famous A. E. E. "Experience Method" has changed all that. You can now get your Electrical training and experience together and thus cut in half the distance between you and the big jobs in Electricity. This real fact is being proven every day by A.E.E. trained men.

The A. E. E. "Experience Method" is the greatest and most remarkable advance ever made in home study Electrical training. There is nothing like it anywhere. It is the result of the lifetime work of Chief Engineer W. N. Littlewood, and over 100 big, successful Electrical Engineers have certified that it is *RIGHT*.

The quick success of men trained under the Famous A. E. E. "Experience Method" is amazing. James DuVall, Fort Niagara, Ont., writes: "How can you put so much information in such a few lines is beyond me." Julio Fuentes, Cleveland, Ohio, just beginning his training, writes: "I am already doing a lot of wiring and repairing and making real money." J. A. Hoekzema, Grand Rapids, Mich., not a third through his training, writes: "I have started my own business and am doing fine." Hundreds of such letters are pouring in from A. E. E. trained men, who began making money almost from the start.

You get real electrical experience while training

The reason for these remarkable successes is that A. E. E. training is not "schooling"—it is EXPERIENCE. You work on practical jobs with practical tools and equipment right from the start—everything that you need is furnished you FREE, as you need it, including the biggest and most practical outfit ever given anywhere. The A. E. E. "Experience Method" is the exclusive development of the A. E. E. and can be had nowhere else.

Success in Electricity Made Easy

YOU can master Electricity quickly and easily under the amazingly interesting and practical "Experience Method."

We guarantee that with a binding Money Back Guarantee Bond. If you can read and write English and are ambitious to make good and qualify for the big jobs that Electricity offers by the thousand, then we will guarantee to do the rest.

Send for this Great Book

It is impossible to tell the remarkable story of the Associated Electrical Engineers on this page. The story is too big—too important. We have published a big new 48-page Book, "Electricity and its Opportunities for YOU," which has a vitally important message for you.

Send for your copy today—it is absolutely free. No matter what your ideas regarding training may be, no matter what your plans are, you should have this book before you decide. It is filled from cover to cover with vital information that every ambitious man should have.

This great book tells of the great opportunities that the amazing growth of the Electrical Industry is creating. It tells you of the many exclusive features of the A. E. E.—the World's Greatest Electrical Training Organization—features that can be had from no other source whatever, and gives you 22 BIG, SMASHING PROVEN REASONS WHY A. E. E. TRAINING IS THE BEST AND MOST COMPLETE AND PRACTICAL IN EXISTENCE.

Your copy of this important book is ready—send for it today.

MAIL THE COUPON

Here is the coupon that will bring you face to face with your BIG OPPORTUNITY. If you are really ambitious, if you wish to get out of crowded, low-pay futureless work and get into the biggest, most interesting and highest paid field on earth—Electricity—then clip and mail the coupon right now.

Five years from now you will be either taking orders or giving them. The coupon will bring the sure way to Independence and Success in Electricity.

Associated Electrical Engineers, 2114 So. Dearborn Street, Chicago

Without any obligation send me your big, new 48-page book telling about the marvellous development of Electricity, and how I can quickly and surely qualify for the great opportunities in this field through the A.E.E. "Experience Method."

Name.....

Address.....

City..... State.....

ABetter Job Now!

Why take small pay from uncertain jobs? Why be buffeted around from this to that, and not know whether you are going to have a job tomorrow or not? You can change all that. Learn a trade. Know autos—how to repair them, and take advantage of the countless opportunities to make big money. Pave the way for a business of your own—a business that can make you independent for life. You can do it with a few weeks' training at the Michigan State Automobile School—the great auto-trade school in the heart of the auto industry.

Be a Trained Man—Successful!

Step out and make a success of yourself. Trained men are wanted all the time—everywhere! More than 15,000,000 autos, trucks and tractors in use. All need service and repairing. Millions of tires, millions of batteries to be kept in commission. More men needed for good jobs. More garages—more electric service stations—more tire-repair shops—welding shops—battery stations needed. This means amazing opportunities for the men who start now. Fit yourself to win a good job, or to start a business of your own. Very small capital is needed. You are right on the threshold of big money if you decide now to make this your business.

Come to the Auto Center



Learn Autos in a Few Weeks by Factory Endorsed Methods

Come to Detroit where autos are made. Come to the Michigan State Automobile School for first-hand experience and knowledge. Great auto factories endorse and recommend "Michigan State" training. *The Packard Motor Co.* says: "We have no hesitation in recommending the M. S. A. S. in every particular." *The Hudson Motor Co.* says: "The best equipped and most efficient school in America." Others say the same. Their executives have investigated this School and know that it is the only one which they can endorse. Learn the business thoroughly on latest equipment. M. S. A. S. equipment is up-to-date, all in good order, all for students actually to learn and practice on. Visit the great Detroit auto-plants. Get first-hand knowledge and a quality-training that means certain success, if you do your part.

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MICHIGAN STATE AUTOMOBILE SCHOOL

A. C. ZELLER, President

591 Auto Bldg. 3729 Woodward Ave.
DETROIT, MICHIGAN

Mail Coupon To Day

MICHIGAN STATE AUTOMOBILE SCHOOL
591 Auto Bldg. DETROIT, MICHIGAN

Gentlemen:—Send FREE and without obligation complete information showing the opportunities and advantages of a Factory Endorsed Detroit-Training to make the most money.

Name.....

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The Factory Endorsed School

Learn Cartooning

At Home—in Your Spare Time

from the school that has trained so many successful cartoonists of today earning from \$50 to \$200 and more a week. The Landon Picture Chart Method of teaching makes original drawing easy to learn. Send 6c in stamps for full information and chart to test your ability. Also state age.

THE LANDON SCHOOL
451 National Bldg., Cleveland, O.



\$90 Drafting Course

FREE

If you accept an offer I am making now you need not pay for the course. I am doing this in order to enable deserving and ambitious men to get into this profession. I will also guarantee to train you until you are placed in a position drawing a salary of \$250.00 a month. Besides I will give you a free complete set of drawing instruments worth \$25.00. Write me for full information.

Chief Draftsmen Bobo, 1851 Lawrence Av., Dept. 13-68 Chicago

Learn Photography at HOME

Make \$75.00 a Week on the Side
Establish yourself as a Photographic Expert quickly—during your spare time—under a leading photographer. I'll show you how to start your own business—or command a large salary. Send for my unusual offer. It's only temporary. Act at once. A postal will do.

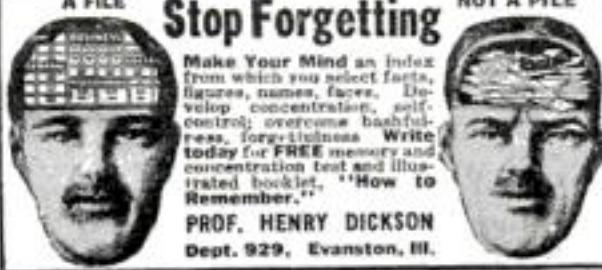
International Studios, Inc., Dept. 13-68
3601 Michigan Ave., Chicago, U. S. A.



A FILE Stop Forgetting

Make Your Mind an Index from which you select facts, figures, names, faces. Develop concentration, self-control; overcome bashfulness, forgetfulness. Write today for FREE memory and concentration test and illustrated booklet, "How to Remember."

PROF. HENRY DICKSON
Dept. 929, Evanston, Ill.



Money Making Opportunities

BUSINESS OPPORTUNITIES

GET money in your mail. "Lambert's Mill Order Secrets" contains successful methods never before published. Particulars free. Leon Lambert, 555-D Kaufman Bldg., Wichita, Kansas.

COMMON Sense and \$100 or more will establish cash business, Dept. R. Paul Kaye, 149 Broadway, N. Y.

\$25,000 from three schemes, \$10,000 from one, subscribers to Schemer Monthly, Alliance, Ohio, report Try your luck. Three special copies 96 pages, only 25¢

MEN, any one can make the Arteov, and money information. Write Arteov Mfg. Co., Newark, N. J.

I MADE \$100,000 as Real Estate Specialist. Free information tells how. American Business Builders Dept. A-3411, 1133 Broadway, New York.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Ave., New York.

LOOK Here Man! Do you want to earn from \$25.00 to \$100.00 per week in your spare time working for us? We send you everything. If you mean business, show it by sending 25¢ and we will include the 25¢ in your first payroll check. This is strictly homework, no canvassing "Bee," 5309 Forest Ave., Kansas City, Mo.

STAMPS AND COINS

NYASSA Giraffes and packet of 52 different scarce stamps, Flume Triangle, large, \$1.00 U. S. Rev., Millimetre scale, perforation gauge and ruler for only 9¢. To introduce our Sudden Service approvals. Fennell Stamp Company, Dept. C, Fullerton Bldg., St. Louis, Mo.

FAMOUS Fenway Outfit—2 triangle stamps, small album, 5 blank approval sheets, 250 hinges, perforation gauge, 5 large French Colonials, 2 special deliveries, animal set, red cross set, packet 55 different, including Abyssinia, Azores, Cape of Good Hope, Bosnia, Congo, etc., 16-page price list, all for 12¢ to new approval applicants. Fenway Stamp Co., Fenway Station, Boston, Mass.

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158 GENUINE Foreign Stamps, Mexico War Issues Venezuela, Salvador and India Service, Guatemala, China, etc., only 5¢. Finest approval sheets 50 to 60%. Agents Wanted. Big 72-p. Lists Free. We Buy Stamps. Established 20 years. Hussman Stamp Co., Dept. 55, St. Louis, Mo.

100 DIFFERENT stamps free to popular approval applicants; postage 2¢. Christensen, 124 Second Street, Milwaukee, Wisconsin.

FOUR unused sets, hinges, 55 different, premium 15¢ Deering, Newton St., Marlboro, Mass.

200 MIXED Foreign 10¢, 50 U. S. each different, 10¢ Marie Stamp Bureau, Villa Park, Ill.

STAMPS, 105 China, etc., 2¢. Album (500 illustrations) 3¢. Bullard, Station AA, Boston.

GREECE, 25 different 15¢. Browne, 90 Kemper St., Wollaston, M. ss.

1000 DIFFERENT Stamps, wonderful quality, \$1.00 C. E. Neales, 122 Florida, Washington, D. C.

NEWFOUNDLAND Stamps sent on approval. Rev. Butler, St. Georges, Newfoundland.

FOREIGN Stamp Packet, sent free. Cornish Company, Schenectady, N. Y.

100 RARE stamps, all different, bargain lists, Stamp Magazine, everything 7¢. Stanton, Niantic, Conn.

FREE 25 different U. S. stamps with 60% approx. 45 different U. S. 10¢. Seidenberg, Merton, Wis.

33 FOREIGN bills, splendid assortment, \$1.00. Otto Oddehon, Independence, Missouri.

BRITISH Colonials, 25 for 10¢. 100 different foreign, 4¢. Set Rheinland as premium for first purchase from approval sheets. Davies Stamp Co., Toledo, O.

NEW \$1.00 Canada 15¢; \$2.00 U. S. 25¢. B. A. Turner, Greensburg Indiana.

SIXTY stamps from thirty different countries 10¢ Mogensen, 414 North 14th, Omaha, Nebraska.

STAMPS, 100. All different, 3 cents. Lists free P. S. Quaker Stamp Co., Toledo, Ohio.

ALL different, 300, 25¢; 500, 50¢; 1,000, \$1.50 Fred Onken, 630 79th Street, Brooklyn.

RARE Coins, Medals, Paper Money. United States, Foreign and Ancient. Old Coin and New Catalogue 10¢. Alexis Mongelle, Box 387, Colorado Springs, Colo.

OLD coins—Large Spring selling catalog of coins for sale, free. Catalog quoting prices paid for coins, 10¢ William Hesslein, 101-B Tremont St., Boston, M. ss.

STAMPS—50 varieties, Africa, Brazil, Peru, Cuba, Mexico, etc., 10¢. 50 different U. S. 25¢. 1,000 hinges, 10¢. 1,000 mixed, 40¢. List free. C. Stegman, 5949 Cote Brilliante, St. Louis, Missouri.

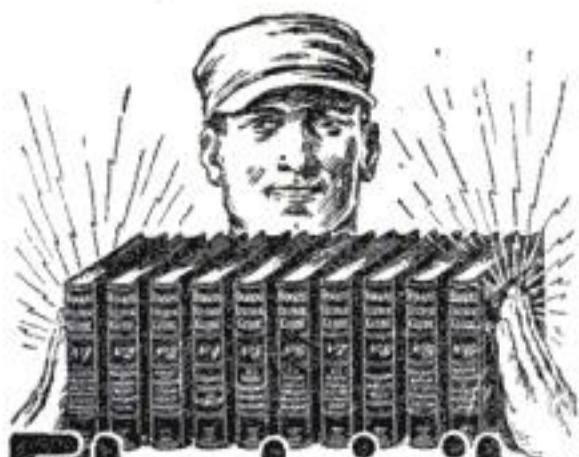
17 VARIETIES Bulgaria stamps, 20 cents. List of 7,000 low-priced stamps free. Chambers Stamp Company, 111 C, Nassau Street, New York City.

CALIFORNIA gold \$1/4 size, 27¢; \$1/2 size, 53¢. White cent and catalogue, 10¢. Norman Schultz, Colorado Springs, Colorado.

\$5.00 FOR 10¢—200 all different (mostly unused) from Ireland, Newfoundland, Jamaica, pictorial, etc. triangle set, airplane set, small album and bargain lists—all for 10¢ to new approval applicants. Victoria Stamp Co., London, Canada.

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More Money Making Opportunities
on pages 6 to 22



Electricity at your finger ends

Know the facts in Electricity. They mean more money and better position for you. Hawkins Guides tell you all you need to know about Electricity.

Every important electrical subject covered so you can understand it. Easy to study and apply. A complete, practical working course, in 10 volumes.

Books are pocket size; flexible covers. Order a set to-day to look over.

HAWKINS GUIDES

3500 PAGES \$1 A VOLUME
4700 PICTURES \$1 A MONTH

These books tell you all about—

Magnetism—Induction—Experiments—Dynamos—Electric Machinery—Motors—Armatures—Armature Windings—Installing of Dynamos—Electrical Instrument Testing—Practical Management of Dynamos and Motors—Distribution Systems—Wiring—Wiring Diagrams—Sign Flashers—Storage Batteries—Principles of Alternating Currents and Alternators—Alternating Current Motors—Transformers—Converters—Rectifiers—Alternating Current Systems—Circuit Breakers—Measuring Instruments—Switch Boards—Wiring—Power Stations—Installing—Telephone—Telegraph—Wireless—Bells—Lighting—Railways. Also many Modern Practical Applications of Electricity and Ready Reference Index.

SHIPPED TO YOU FREE

Not a cent to pay until you see the books. No obligation to buy unless you are satisfied. Send Coupon now—today—and get this great help library and see if it is not worth \$100 to you—pay \$1.00 a month for ten months or return it.

SEND NO MONEY

THEO. AUDEL & CO.,
72 Fifth Ave., N.Y.

Please submit for examination
Hawkins Electrical Guides
(Price \$1 each). Ship at once, pre-
paid, the 10 numbers. If satisfactory, I
agree to send you \$1 within seven days and
to further mail you \$1 each month until paid.

Signature _____
Occupation _____
Employed by _____
Residence _____
Reference _____

11T34

MEN WANTED



\$10 to \$20 a Day

for 6 to 8 hours. You get your pay in advance. We deliver and collect. Commissions paid on repeat orders. Exclusive territory. Capital not necessary. Write

THE STEMCO
ENGINEERING CO.
201 Webb St., Dayton, Ohio

EARN MONEY AT HOME

IN your spare time writing show cards. No canvassing or soliciting. We instruct you fully. Write today without obligation for full particulars and free booklet.

WEST-ANGUS SHOW CARD SERVICE LIMITED
Many satisfied pupils our best reference.
63 Colborne Buildings, Toronto, Can.

The Real Estate Educator

This book gives a most comprehensive yet most concise arrangement of useful facts about buying, selling, leasing and sub-letting of Real Estate, contracting, for erection or repairs, mortgaging, transferring, insuring, etc. Cloth, 256 pages. Price \$2.00, postpaid. Popular Science Monthly, 250 Fourth Avenue New York City.

Can you read this?

O s o d e o d .

(Translation: In this system you must first learn your symbols.)

Can you read this?

O t r n o o b c .

(Translation: Also in this system you must first learn your symbols.)

Now read this—

n spdrig u lr no u smbs.

(Translation: In Speedwriting you already know your symbols.)

THE last line is *Speedwriting*, a remarkable new discovery that takes the place of shorthand.

Now everyone can write shorthand the new easy way.

All the business world needs shorthand because shorthand saves time. Time is money. Timesaving means success. Shorthand should be a business tool not only for the commercial stenographer, but the typist, the office worker, the business executive, professional men, the writer, the news reporter. You should be able to put thought on paper with the speed of thought itself.

But few in the business world can spend the hours of laborious study necessary in mastering the usual shorthand systems.

Why do so few use shorthand?

The answer is simple. The symbols of the usual shorthand systems are totally unfamiliar. Hundreds of them must be memorized for efficient work. The strokes must be drawn with absolute accuracy or they mean something totally different—your notes are worse than useless. The usual course requires about eight months of classroom work.

A national authority on shorthand discovers a totally new method—*Speedwriting* the business tool for everyone.

Miss Emma B. Dearborn who discovered the principles of *Speedwriting* was herself a teacher for many years of the formal systems of shorthand. She is today one of the leading

national authorities on the leading methods employed in these systems. But these years of classroom teaching in such leading educational institutions as Columbia University, Simmons College, University of California, Rochester Business Institute, etc., convinced Miss Dearborn that ordinary shorthand systems would always remain too difficult for mastery except by the few with a special aptitude or willingness to give a special amount of time to learning them. She decided therefore, to develop a shorthand system without the usual shorthand symbols. From her research and experiments finally came the discovery and perfection of *Speedwriting*.

What is *Speedwriting*?

Speedwriting is not a shorthand in the sense that it uses arbitrary and unfamiliar symbols but it is shorthand in its results.

Those who write it can set down on paper the thought of the person dictating or their own thoughts as fast as they come—not with the hooks and curves that mean ordinary shorthand, but with your old familiar a, b, c's like this:

th lsou hw ezts tlrn hw
ezts tri a hw ezts tred.
tmab rin o t tipRi or w
pnsl asulk.

(This will show you how easy it is to learn, how easy it is to write, and how easy it is to read. It may be written on the typewriter, or with pencil as you like.)

Speedwriting the Natural Shorthand

Now you see why we call *Speedwriting* the Natural Shorthand. Your a, b, c's come to the tip of your pen or pencil or the tips of your fingers on the typewriter keys without a thought. *Speedwriting* is offered as a Home Study Course under Miss Dearborn's personal supervision, consisting of sixty easy, interesting exercises each requiring about fifty minutes to master. You will be delighted after the first few lessons to see how you are putting to work a latent power you did not know you had.

With *Speedwriting* you will find new doors of opportunity opening to you. You will have a

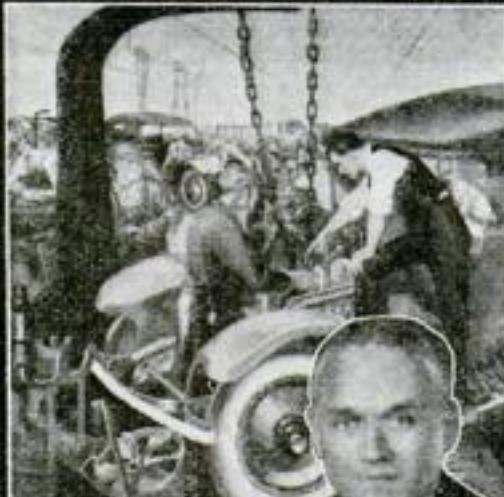
new strength in business competition. Don't overlook this opportunity to make this remarkable new discovery—*Speedwriting*—the Natural Shorthand, a part of your own business equipment. Fill out and mail the coupon at once.

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30 Days Ago They Laughed at Me

I never would have believed that anyone could become popular overnight. And yet—here's what happened.

ONE evening, about a month ago, I went to a dance where there was a young woman I had long wanted to meet. Someone introduced us, and before I knew it I was dancing with her. That is, I was trying to dance with her. She was an exquisite dancer, graceful, poised, at ease. Her steps were in perfect harmony with the music.

But I, clumsy boor that I was, found myself following her instead of leading. And I couldn't follow! That was the sad part of it. I stumbled through the steps. I trod on her toes. I tried desperately to keep in time with the music. You cannot imagine how uncomfortable I was, how conspicuous I felt.

Suddenly I realized that we were practically the only couple on the floor. The boys had gathered in a little group and were laughing. I knew, in an instant, that they were laughing at me. I glanced at my partner, and saw that she, too, was smiling. She had entered into the fun. Fun! At my expense!

I felt myself blushing furiously, and hated myself for it. Very well. Let them laugh. Someday I would show them. Someday I would laugh at them as they had laughed at me.

All the way home I told myself over and over again that I would become a perfect dancer, that I would amaze and astonish them. But how? I couldn't go to a dancing school because of the time and expense. I certainly couldn't afford a dancing instructor. What could I do? A daring plan flashed through my mind. I would show them that they couldn't laugh at me.

Popular Overnight!

I ran upstairs and found a magazine I had been reading the night before. One clip of the shears, a few words quickly written, a trip to the corner mail-box—and the first part of my plan was carried out. I had sent for Arthur Murray's free dancing lessons.

Somehow I didn't believe that dancing could be learned by mail. But there was nothing to risk—and think of the joy of

being able to astound them all at the dance.

The free lessons arrived just the night before Jack's dance. I was amazed at the ease with which I mastered a fascinating new fox-trot step. I learned how to lead, how to have ease and confidence while dancing. It was fun to follow the simple diagrams and instructions. I gained a wonderful new ease and poise. I could hardly wait for Jack's dance.

The following evening I asked the best dancer in the room to dance with me. She hesitated a moment, then rose—smiling. I knew why she smiled. I knew why Jack and the other boys gathered in a little group. Good! Here was my chance.

It was a fox-trot. I led my partner gracefully around the room, interpreting the dance like a professional, keeping perfect harmony with the music. I saw that she was astonished. I saw that we were the only couple on the floor and that everyone was watching us. I was at ease, thoroughly enjoying myself. When the music stopped there was applause!

It was a triumph. I could see how amazed everyone was. Jack and the boys actually envied me—and only 30 days ago they had laughed at me. No one will ever laugh at my dancing again. I became popular overnight!

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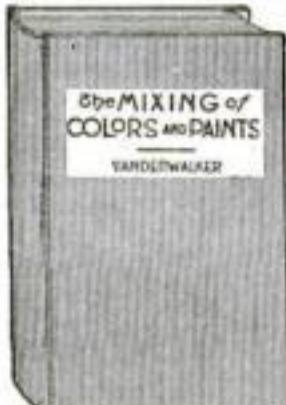


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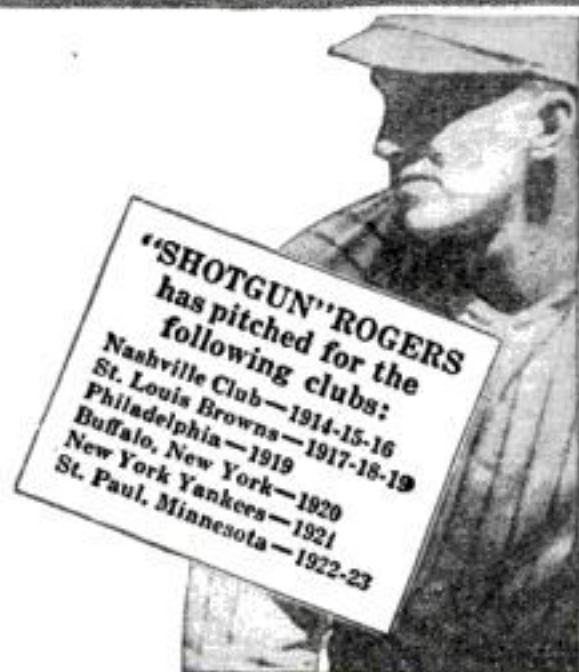
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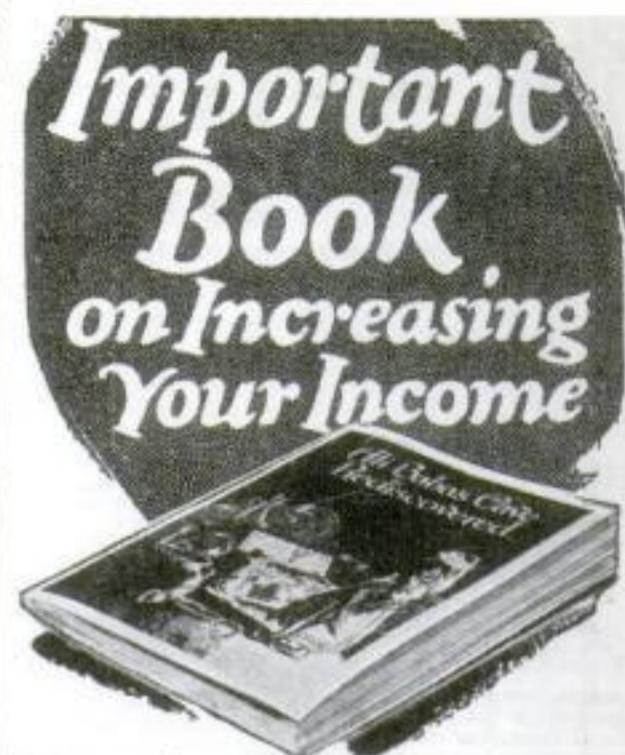
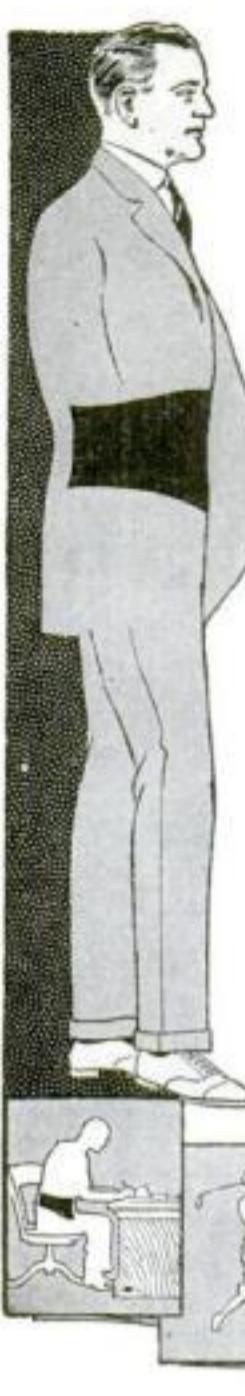
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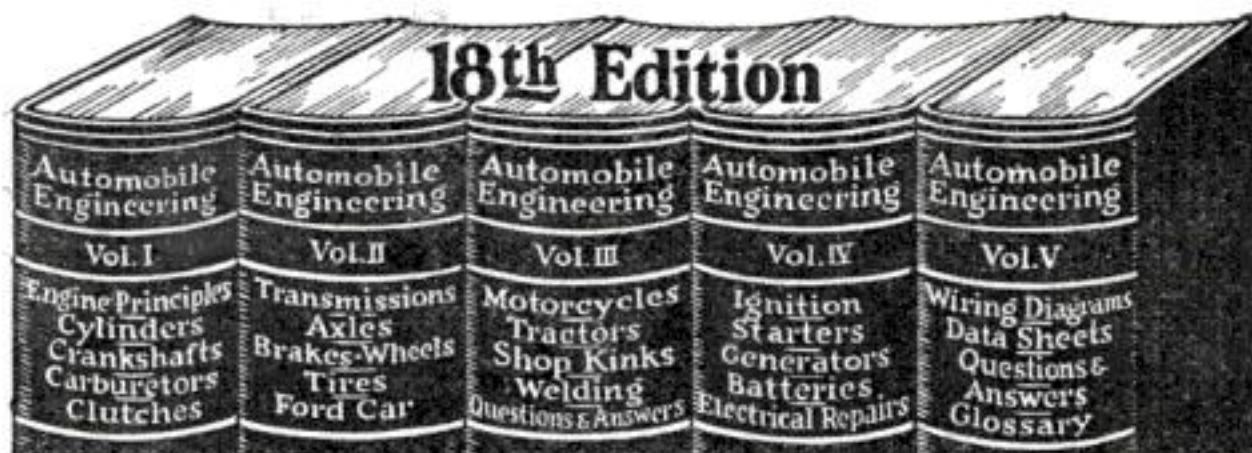
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September 4, 1924.

DEPARTMENT OF
MECHANICAL ENGINEERING

Boyce & Veeder Company,
Long Island City,
New York.

Gentlemen:

Referring to the recent investigation conducted under my direction at the Sage Engineering Research Laboratories of New York University, regarding the use of Boyce-ite in a Ford touring car, you are invited until it developed on a car, the engine of which had been carbonized hard to start and poor in hill climbing due to loss of power. The car was then removed and a laboratory test made for horse power and fuel consumption.

The engine was then re-installed in the car. Boyce-ite was used in the proportion of one 4 oz. can to ten gallons of gasoline and the car was driven a distance of 946 miles with this mixture over a period of eight days.

After careful inspection of the pistons, cylinders and valves, a second laboratory test was made on the engine to ascertain the results produced by Boyce-ite.

The conclusions evident from the data secured during the above tests prove that -

1 - Boyce-ite removed the carbon to a sufficient extent to put the engine back in its original good working condition.

2 - During the 8-day road test covering 946 miles of driving with Boyce-ite on the gasoline the mileage was increased from 16.7 miles per gallon on the first day to 21.7 miles per gallon on the last day.

3 - The laboratory tests substantiated the road tests on fuel consumption and showed an average increased H.P. of 8-2/3%.

A further test was made to determine the effect of Boyce-ite on the materials of automobiles. For this purpose chemical tests were conducted. These chemical tests on the materials of construction prove conclusively that Boyce-ite has no injurious effect on such metals.

Very truly yours,
Collins P. Bliss
Professor of Mechanical Engineering, and
Director of Testing Laboratories.

Boyce-ite is a secret compound which when added to gasoline in the correct proportions (4 ounces to 10 gallons) tends to remove carbon from the engine and prevents more carbon forming. Because of this, engines using Boyce-ite treated gasoline continuously develop

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- greater flexibility
- smoother operation

Boyce-ite eliminates forever the necessity of grinding valves or burning out carbon.

Harrison Boyce

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This advertisement copyrighted by Harrison Boyce.



Here three loudspeakers are being tested through the piano range of musical frequencies. Only loudspeakers—as well as all other radio products and tools—that pass the rigorous tests of the Institute of Standards are permitted to be advertised in Popular Science Monthly.

HOW THE INSTITUTE TESTS LOUDSPEAKERS

By Hazen G. Tyler, M.E., E.E.

*Associate Director,
Popular Science Institute of Standards*

WITH the advent of the broadcasting of political campaigns, many readers of POPULAR SCIENCE MONTHLY are undoubtedly planning to add a loudspeaker to their radio equipment—and want a loudspeaker that will give satisfactory results.

The following points upon which we base our tests are essentially those that a purchaser would consider:

1. External appearance
2. Workmanship
3. Volume of reproduction
4. Quality of reproduction
5. Clearness of reproduction
6. Efficiency

The preliminary inspection includes such points as shape, mechanical construction, principle of operation, and material used. Whether the loudspeaker takes the form of a horn, box, or lamp is a matter of the individual preference of the purchaser and makes little difference as far as our tests go—that is, unless such construction interferes with the efficiency of the product.

Then come the actual tests. In order to determine volume, quality, and clearness of reproduction, we have erected a miniature transmitting station, which permits us to make certain tests that would be impossible in the reception of ordinary broadcasting. This does not mean, however, that no tests are conducted under normal conditions. On the contrary, in order to gain a general impression of the reproduction of a loudspeaker, it is essential that the regular stations should be brought in.

Since the piano is the most difficult instrument to reproduce, in testing a loudspeaker for quality of tone, we always have our laboratory station broadcast piano music. Since it often happens that an instrument that is true to tone, and reproduces music in all its original richness, will distort speech, causing vibrative and metallic noises, we therefore also test a speaker on speech reproduction. Then the speaker is tried out on various instruments and finally on regular broadcast station programs.

In testing the volume of loudspeakers and the effect of plate voltage upon the operating characteristics of the speaker, we connect it with the receiving set through a transformer and simulate the plate-current effect by separate battery. In this way we can determine how the

instrument will operate with various values of plate voltage as determining the ratio of signal current to sound output. Another important consideration is the amount of input on which a loudspeaker will operate satisfactorily. An instrument that will take a high input and give good quality is necessary when sufficient volume for entertainment of a large audience is desired.

Again, in the laboratory test for quality of production of a loudspeaker, we test its response to a wide range of frequencies by use of our private "broadcasting station" and the audio-frequency oscillators.

The loudspeaker is tested through the piano range of musical wave frequencies by having it reproduce the individual notes of the piano. Also it is tested for the reproduction of combination of harmonic frequencies. Some inferior loudspeakers will respond to a limited range of frequencies and will not reproduce the whole range of audible sound. For example, they will not reproduce clearly the highest tone of the piano.

Lack of space prevents us from going into a description of the quantitative tests made. However, the tabulated records of these tests figure largely in our final conclusions leading to approval or disapproval of a product.

A loudspeaker that can survive these rigorous scientific and practical tests and find its way into the advertising columns of POPULAR SCIENCE MONTHLY is surely worthy of purchase.

Send for List of Approved Products

POPULAR SCIENCE MONTHLY will be glad to furnish a list of Radio and Tool Manufacturers whose products have been approved by THE INSTITUTE.

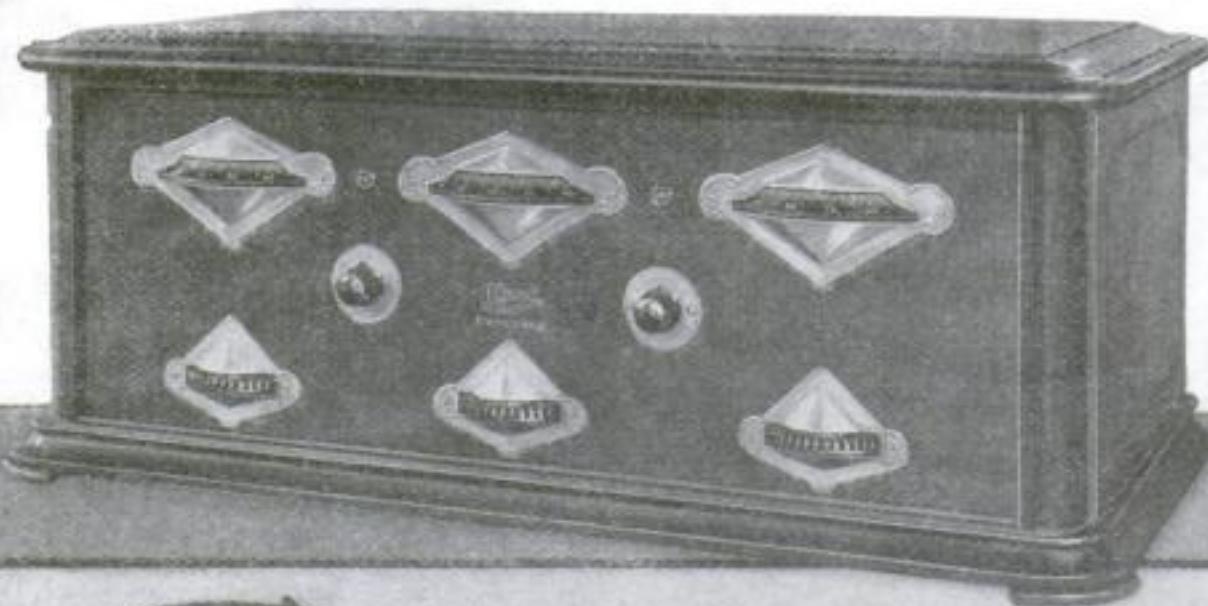
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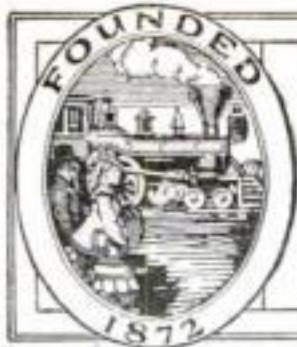
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POPULAR SCIENCE MONTHLY

SUMNER N. BLOSSOM, Editor

November, 1924



If You Had to Leap from a Falling Plane—

How you could save yourself with a bit of silk—A thrilling story of aviators plunging to safety through miles of sky—Amazing new life-preservers of the air and what they mean to the progress of aviation

By Corley McDarment

THE layman need only recall the round-the-world flight, the successful installation of transcontinental aerial mail service, and the amazing speed records made by airplanes in the last few months, to realize that developments in aviation have kept pace with recent developments in other branches of science.

And yet more than on any refinements of power plant or body lines that can be expected in the immediate future, the future of aviation, especially along commercial lines, probably depends on a compact bundle of silk, which the aviator wears strapped to his back and which, except in emergencies, he uses merely as a cushion to increase his comfort while he sits in the cockpit of his craft!

FOR this little pack, in appearance not unlike the blanket roll of a hiker off on a week-end jaunt, is a parachute—the life-preserver of the air. By it flying has been made more safe, for pilot and passenger alike, than it ever has been before. It permits the occupants of a disabled airplane plunging to certain destruction to leap for their lives—and by its use to save themselves. And thus it removes one of the greatest obstacles to the general employment of aircraft for commercial purposes—the necessity of endangering human life in flying.

The airplane parachute already has proved its capabilities, not only in test, but in actual use in the last few months

under the most dramatic circumstances. At least seven members of the Army Air Service owe their lives to the fact that their parachutes worked as they were supposed to work when their planes, many feet above the earth, became unmanageable.

adapted to the airplane. It could not be carried within the fuselage, neither was there space available along the sides to accommodate a long, heavy mass of cloth.

The airplane parachute had to be light, compact, fireproof, capable of being folded so that the aviator could carry it with him constantly, and so constructed that it would not catch on the structure of the plane during the jump. These conditions obviously were difficult to meet in a parachute that would be strong and tough enough to withstand the strain of opening suddenly to oppose the fall of a heavy man, and then to carry its wearer safely through a fall of possibly several miles. But the problem was solved, and successfully.



Will the parachute open? The most thrilling experience in the life of an aviator—the moment he steps backward from the wing of a plane and prepares to release his parachute. This remarkable

photograph shows Marine Sergeant Ford plunging from a plane 2500 feet above New York Harbor. His silken umbrella, released with a single pull, carried him to safety half a mile below

Now, of course, these parachutes that are the life-rafts of aircraft are no ordinary parachutes. They are quite unlike the cumbersome umbrella-like apparatus that balloonists have used for years to thrill the crowds at county fairs and similar gatherings.

The parachute of the stunt-performing aeronaut was too big and unwieldy to be

constructed of a strong and durable silk.

Forty shroud lines, each capable of withstanding a pull of 350 pounds, and a parachute 24 feet in diameter can be bundled so compactly that the wearer suffers no discomfort while the apparatus is folded on his body, and yet so handily that with a single pull the parachute opens perfectly without interference between

ropes or folds. The folding of an airplane parachute into a pack is one of the most intricate operations of the kind that could be imagined.

THE parachute and its shrouds are spread flat on two long tables and the folds made in a prescribed manner that must be exact to the part of an inch. Newspapers are placed between folds and the whole is made into a compact bundle that is incased in a canvas cover.

A web "harness" attaches the parachute to the aviator's body. The canvas cover is held snug over the 'chute by means of elastic bands, criss-crossed, so that at a single pull of a steel cord the bands snap back, strip the covers from the parachute and permit it to drop out and unfold.

Pulling this cord, whether in case of necessity or in performing a test, is the most thrilling experience an airman can undergo, for there is always the question "Will the parachute open?" None has

chute, those who have made jumps tell me, is a period of indescribable agony, for the body of the jumper plunges toward the earth like a plummet the instant he steps from the plane, falling several hundred feet in a few seconds. Even after the rip cord has been pulled, the jumper is in a torture of suspense until the parachute opens, an operation that usually requires a little less than two seconds. When he feels the parachute "catch hold," though, his fears pass, and the journey to the ground is described as being rather enjoyable.

AN EXPERIENCED pilot, having spent some little time in thinking over the parachute question, probably will have made up his mind that if ever occasion arises that requires him to jump to save his life, he will step "overboard" and pull the release ring. This habit of forethought about possible emergencies is one of the most substantial and valuable contributions to the power of modern aviation.

Passengers, who are seldom aviators, are likely to be filled with entirely human misgivings about plunging off what seems to be the brink of eternity and rarely think beyond the terrors of the minute.

Only a few weeks ago a soldier from Bolling Field, the air station near Washington, D. C., narrowly escaped death because of his reluctance to jump from a disabled plane. This man had been in the Air Service only a short time, and was not accustomed to flying. A pilot had taken him up about 4000 feet, at which height he tried some stunt flying.

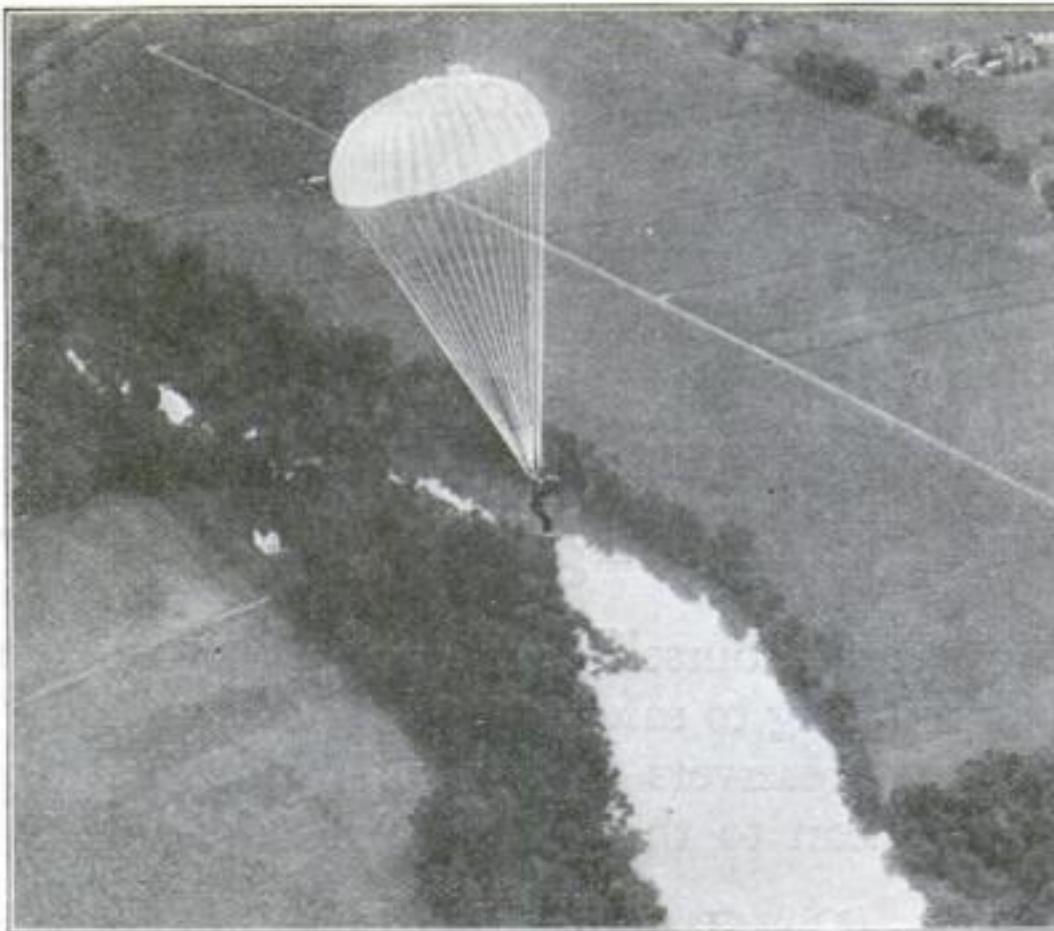
After several loops, the pilot put the



A rent in a parachute does not necessarily cause disastrous results. This parachute carried an aviator safely to the ground from a height of 20,600 feet after the silk had fouled a part of the plane, resulting in the tear shown above

failed yet, and still, no matter what refinements may be made in them, the danger always will exist that a trifling bit of carelessness in packing, an unsuspected weakness in some part of the apparatus, will cause the parachute to remain folded or its shrouds to become twisted and so result in its wearer's plunging to death.

A parachute jumper leaves a plane backward. This reduces the likelihood of his parachute's catching on the wing structure, and also permits him to see that he is clear of the plane before pulling the release ring. The time between leaving the plane and releasing the para-



Floating downward over a river. After the first agonizing plunge before the 'chute opens, the descent is described as quite enjoyable. By pulling the cords on either side of the parachute the jumper is able to guide himself away from obstacles

ship into a tail spin. This was accomplished perfectly, and the plane responded when the pilot attempted to "kick" it out of the spin.

But when he endeavored to bring the nose up to the horizon, though, the controls had no effect, and the plane dived. All attempts to right it failed, so the pilot opened the compartment that separated him from his passenger and peremptorily ordered the latter to jump.

THE passenger seemed not to understand. Frantically the pilot tried to explain things while the plane plunged down and down. At last the pilot managed to get his passenger out on a wing and off the plane.

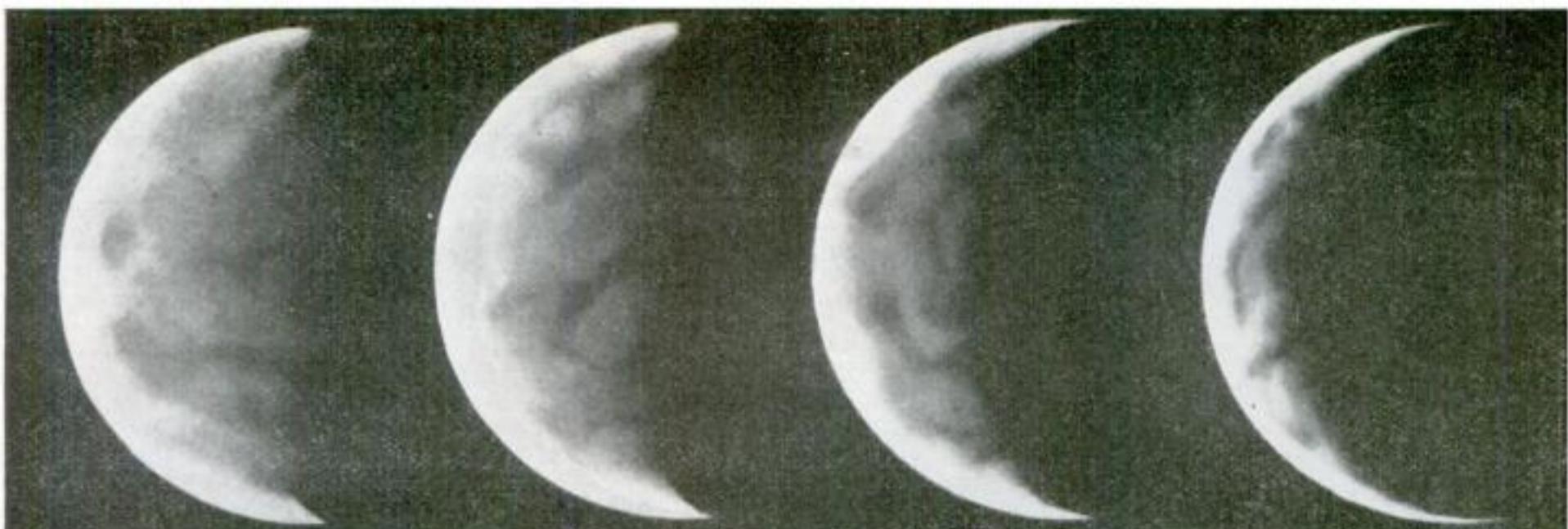
An instant later and the pilot left the plane himself — and none too soon, for the plane had fallen almost 3000 feet while the men argued, and was within 500 feet of the ground. This is about the lowest height from which a parachute jump can be attempted with safety. In this case, had the pilot's 'chute been slow in catching the air, he most certainly would have been killed.

Aviation has its "unwritten laws" just as has the sea. One of these is that the pilot must not jump before his passenger is safely out of a disabled craft. One pilot at Wilbur Wright Field, Fairfield, Ohio, however, did leave his plane before his passenger a few months ago, though through no fault of his own. He

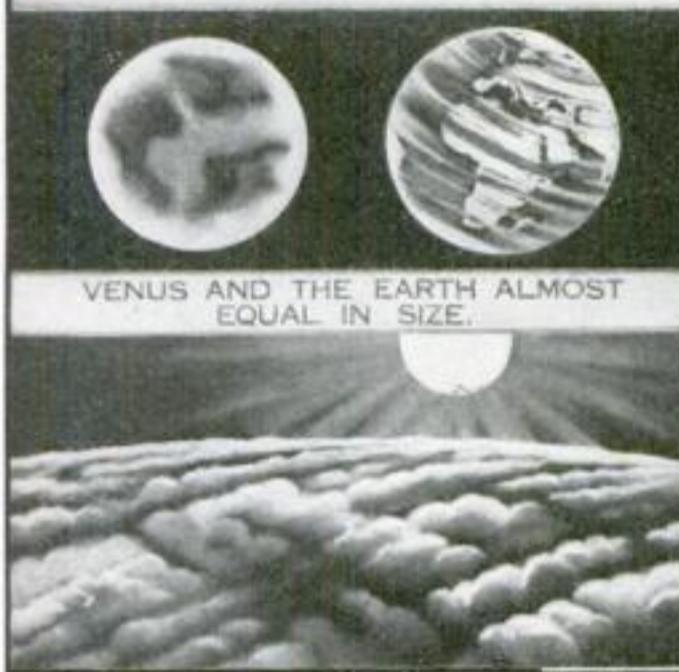
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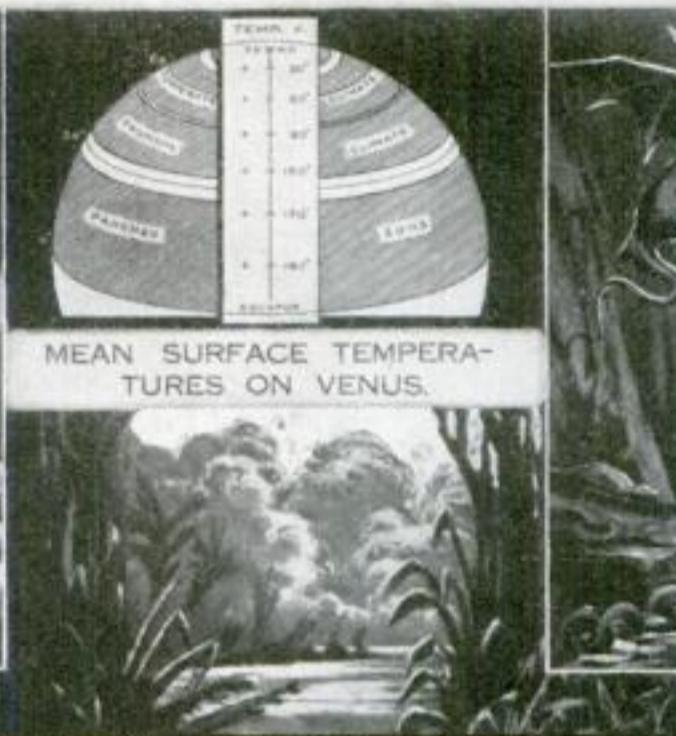
Folded carefully into a little pack strapped to the flier's back, the parachute serves as a cushion while flying. Notice the pull ring, a tug at which releases and unfolds the parachute as the flier drops toward earth



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Tropical Venus may be luxuriant with vegetation and dominated by monsters

Drawn by Scriven Bolton, F.R.A.S., for POPULAR SCIENCE MONTHLY

Lifting the Veil from Venus

Is Our Sister Planet Teeming with Ferocious Monsters?

By Scriven Bolton, F.R.A.S.

WHILE Mars, our older brother in the family of planets, has been holding the stage in one of his periodic visits, astronomers have been quietly busy seeking a closer acquaintance with our younger sister planet, Venus, which forever hides her face behind a heavy veil of clouds.

Recent observations with telescopes and spectroscopes at Leeds, England, have established new evidence concerning the length of the Venutian day. They have led also to fascinating new speculation concerning the life on this comparatively young planet—a planet that we may very well believe is dominated by grotesque and ferocious monsters—huge reptiles and winged dragons such as lived on earth five million years ago.

Venus is nearly a twin sister of our Earth in size and mass. She also is the nearest to the Earth of the large planets—her average distance from us is 67,000,000 miles. Yet we have been able to learn

comparatively little about her. This is because the surface of the planet is concealed by a thick cloud veil extending to the astonishing height of 80 miles.

The recent observations indicate that this outer canopy completes one revolution in about 20 days. From this fact we may believe that the actual surface of Venus completes a revolution in about the same time our Earth does. This assumption is substantiated by the fact that in 1883 dust from the volcano Krakatoa, thrown to a height of 70 miles, took 20 days to complete a revolution.

Venus seems to be more like Earth than any heavenly body known. Although her surface temperatures, latitude for latitude, must be higher than on Earth, beings similar to us might find suitable abode near the poles. The exceedingly moist climate must be productive of abundant vegetation and teeming animal life, similar to that on Earth when fierce monsters dominated regions that were still in the terrible throes of evolution.

Scriven Bolton's conception of a fierce dragon such as he believes may inhabit the tropics of Venus





How would you like to meet this face while you were in swimming? The great-toothed dogfish is one of many dangerous creatures that inhabit the waters of British Guiana

By Fritz Blocki

THILLS? Adventures? You can't very well go into the jungle without having them. The peculiar thing is, though, that when you're in the jungle as a member of a scientific expedition, you're not likely to be conscious that you're undergoing an adventure until after it is all over. What you're interested in at the time is capturing a particular specimen of bird, beast, reptile, or fish—whatever it may be.

"That the specimen may chew your hand off or leave the mark of its claws on your face in its effort to get away somehow doesn't seem to occur to you while the fight is on. It isn't until afterward, when you sit down to think things over at your leisure, that the thought strikes you that you may have had a narrow escape."

IT WAS William Beebe talking. He is honorary curator of ornithology at the New York Zoological Park, known more familiarly as the "Bronx Zoo," and is director of the tropical station of the New York Zoological Society. He had just returned from a five-month expedition into the wilds of British Guiana, South America, in search of zoological specimens to add to the Bronx collection. He had brought back innumerable cages filled with queer jungle creatures, some of which never before had been seen in this country. Among these were tree-climbing porcupines, agoutis, long-tailed rodents, and yellow headed vultures.

Beebe is a very tall, very slim man of 47, who looks like a scholar, and talks like one—in precise phrases, uttered softly and rather diffidently. His face, his hands and forehead have been burned to the hue of mahogany by the tropic sun on his many expeditions into the wilds. Otherwise, in neither appearance nor manner does he suggest his adventurous calling. Yet on more than one occasion he has attacked and subdued some of the fiercest creatures of the jungle with no weapon more dangerous than his bare

hands and his courage.

On the expedition from which he just returned he lay in his cabin one night and permitted a vampire bat to creep over his body, hoping that the creature would sink its teeth in his flesh and thus permit him to disclose to science for the first time the sensation of having one of these strange and elusive ani-

mals suck the blood from his veins!

"About the most disquieting time we had on the expedition," Beebe told me, "came one night when we were hunting nothing but a breath of air. Several of us were wandering about in the jungle, picking our way among the enormous trunks of the giant mora trees, and little think-

of any kind—not even a pocket-knife. And then, a most extraordinary thing happened. The jaguar turned about, as if bored, and marched calmly and leisurely away!

"**A** DAY or so later we had a real adventure—one in which the danger was real and present—yet there wasn't one of us who thought of possible perils until it was all over. We had our headquarters in a large bungalow in a clearing at the edge of the jungle at Cartabo, a point of land at the junction of the Mazaruni and Cuyuni rivers. The whole party was in camp one afternoon when I happened to notice what appeared to be a large stick protruding from the water at an angle and floating down the river toward us.

"'An ant-eater! Let's get him!' I shouted to the others of the party.



An exciting moment in the jungle. Two women members of the expedition have just captured a great rainbow boa with their hands, after a thrilling struggle in which they barely escape being encoiled. William Beebe, leader

of the expedition, is seen at the right examining the great snake, which is more than nine feet long and several inches in diameter. It is now housed in the New York Zoological Park with many other members of its species

ing of any danger in store for us.

"Suddenly one of the party gave an involuntary gasp, and pointed toward a pool of moonlight that filtered through the trees not 50 feet away. In the center stood a full-grown jaguar, glaring inquisitively at us with furtive, glowing eyes!

"We stopped abruptly. There wasn't a thing we could do save to stand there. In the whole party there wasn't a weapon

"We got nets and oars together, jumped into two rowboats and started down the stream. We caught up with the beast and entangled it in our nets. The ant-eater threshed the water, slashed the air with its long nose, splintered the oars we thrust at it, and fiercely fought off our attempts at capture. And at last it hooked its big curved claws over the gunwale of my boat, and climbed aboard.

"Fighting an enraged ant-eater in the

Waiting in the Dark Vampire Bat

The Amazing Adventures of a
in Guiana Jungles the

for the Bloodthirsty to Bite Him!

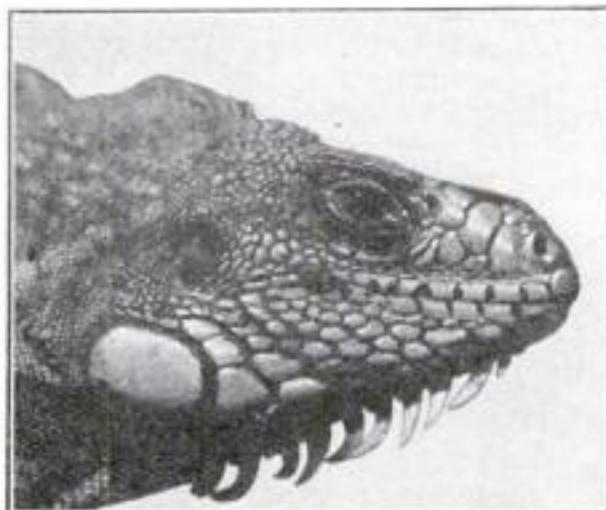
Scientist-Explorer Who Found World's Oddest Creatures

cramped quarters of a small boat is about as thrilling an undertaking as I can imagine. Yet we went about it calmly and carefully. I was nearest to the animal, so I engaged its attention with an oar while the others worked the boat ashore.

"When the boat grounded, we drove the animal out, surrounded it, and kept it at bay with sticks and clubs, seeking to prevent it from clawing its way through us to freedom until some one could obtain a box or crate in which to imprison it. One of the women members of the party, without pausing for orders, busied herself about providing this, to find that the only crate we had large enough to accommodate an ant-eater was already occupied by a boa constrictor that had been captured a few days before!"

SOME women may be afraid of snakes, but this one isn't. She reached down, picked up the boa, and without any hesitation thrust it into a smaller box while the two other women members of the expedition rushed down to the shore with the packing-case. At last we succeeded in driving the infuriated ant-eater into this. Then we were able to take a calmer view of our captive.

"It was one of the largest ant-eaters I have ever seen. Its eight feet of length included a nose almost two feet long. This is what we had seen in the water, for the rest of the animal's body is submerged when it swims. The body was covered with long, coarse black hair, and it had a great bushy tail. The claws were fully three inches long—more than twice the size of a lion's claws—and curled backward and upward so that the points would not become dulled in walking."



Head of an iguana lizard six feet long. This creature, found in South America, is a survivor from the Age of Reptiles. Scientists believe it closely resembles the mammoth lizards that roamed the earth millions of years ago, long before man appeared.

Photos
courtesy
N. Y.
Zoological
Society

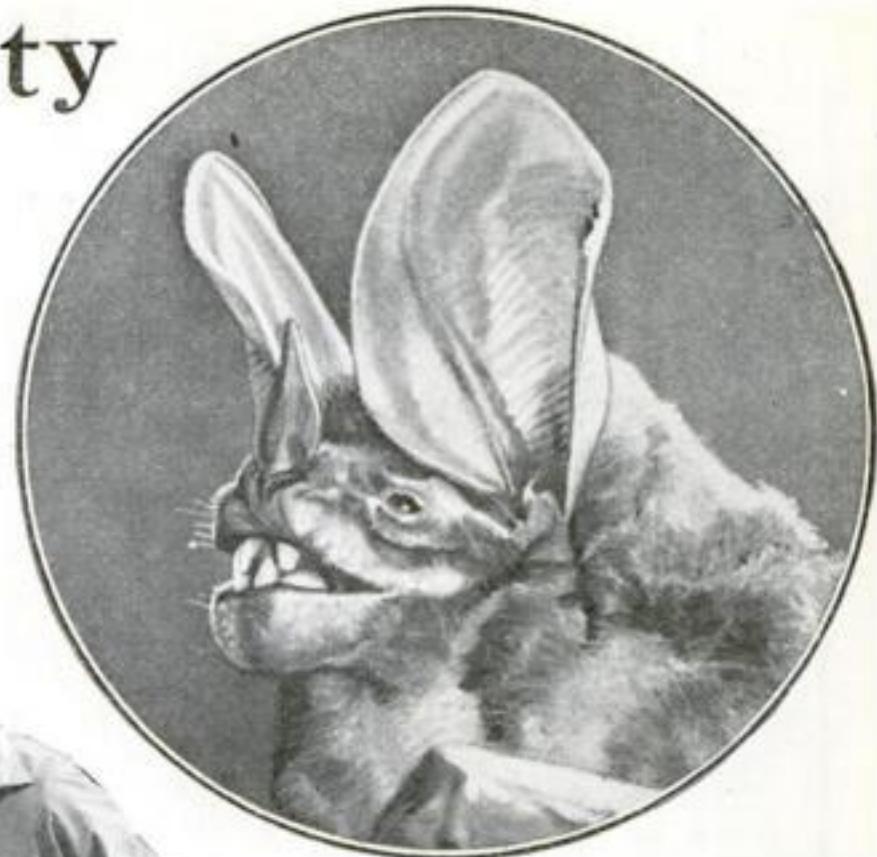


Would you dare to do this? With one hand Miss Isabel Cooper, artist of the expedition, is making a portrait of a jungle snake which she holds firmly with the other. And she seems to enjoy it!

"Ant-eaters, you know, live on ants and antlike creatures called 'termites.' They tear open the nests with their claws and lick up the insects with their tongues, which are longer even than their noses. We couldn't supply our captive with its customary diet, but after a little experimenting devised a ration that seemed to suit it very well—eggnogg three times a day; a half dozen eggs and several quarts of milk.

THREE was another afternoon of excitement when the women members of our party were alone in camp. Suddenly some of the natives started a frightful hubbub, shouting that an enormous snake was approaching in the underbrush. Running toward it, the women saw that it was a rainbow boa, more than nine feet long and several inches in diameter. This snake is beautiful and not poisonous, so they decided to capture it.

"One of the women made a dive for it, seeking to seize it behind the head, but the snake was too quick, and a real battle was on.



A devil-headed jungle bat from the tropics. This is one of the world's strangest creatures that William Beebe brought back from his recent expedition into the wilds of South America

"Several times the women barely escaped being encoiled. At last, though, they managed to drag the boa to an empty packing-box and to dump it inside. This snake is now housed at the Bronx Zoo.

THE wonders of the wild life of the tropics furnish much more interest to a scientific expedition, of course, than do the possibilities of adventure. For instance, we found an insect that looks a good deal like our common ant. These little creatures, though, are able to destroy a house in a short time! They are called 'termites.' They live entirely on wood. When millions of them attack a wooden dwelling or a tree, it soon crumbles into a heap because so many tiny holes have been bored in it. The termites build great nests on the limbs and trunks of trees that are found by the ant-eaters and torn to pieces.

"Another interesting pest makes farming almost impossible down there. One night an army of these walked off with the entire garden that one of our party had planted. These insect robbers, which also resemble our common ants, did the job so completely that the only trace of garden left was a bare patch of earth.

"When we awoke in the morning, and found the garden gone, our friend rushed out, amazed and bewildered, just in time to see the results of his labors winding in a tiny crooked path along the ground. The garden was literally moving into the jungle before his eyes in thousands of tiny pieces of green!

"These pests are called 'leaf-cutting ants.' They live on green leaves that they carry off and chew but do not eat. They swing these little bits aloft, carrying them upright in their mouths like little green banners as they wend their way back to their nest, which may be as far as a quarter of a mile away. They remind one of a cavalcade of tiny warriors going off to battle in single file and carrying tall green spears before them.

(Continued on page 153)

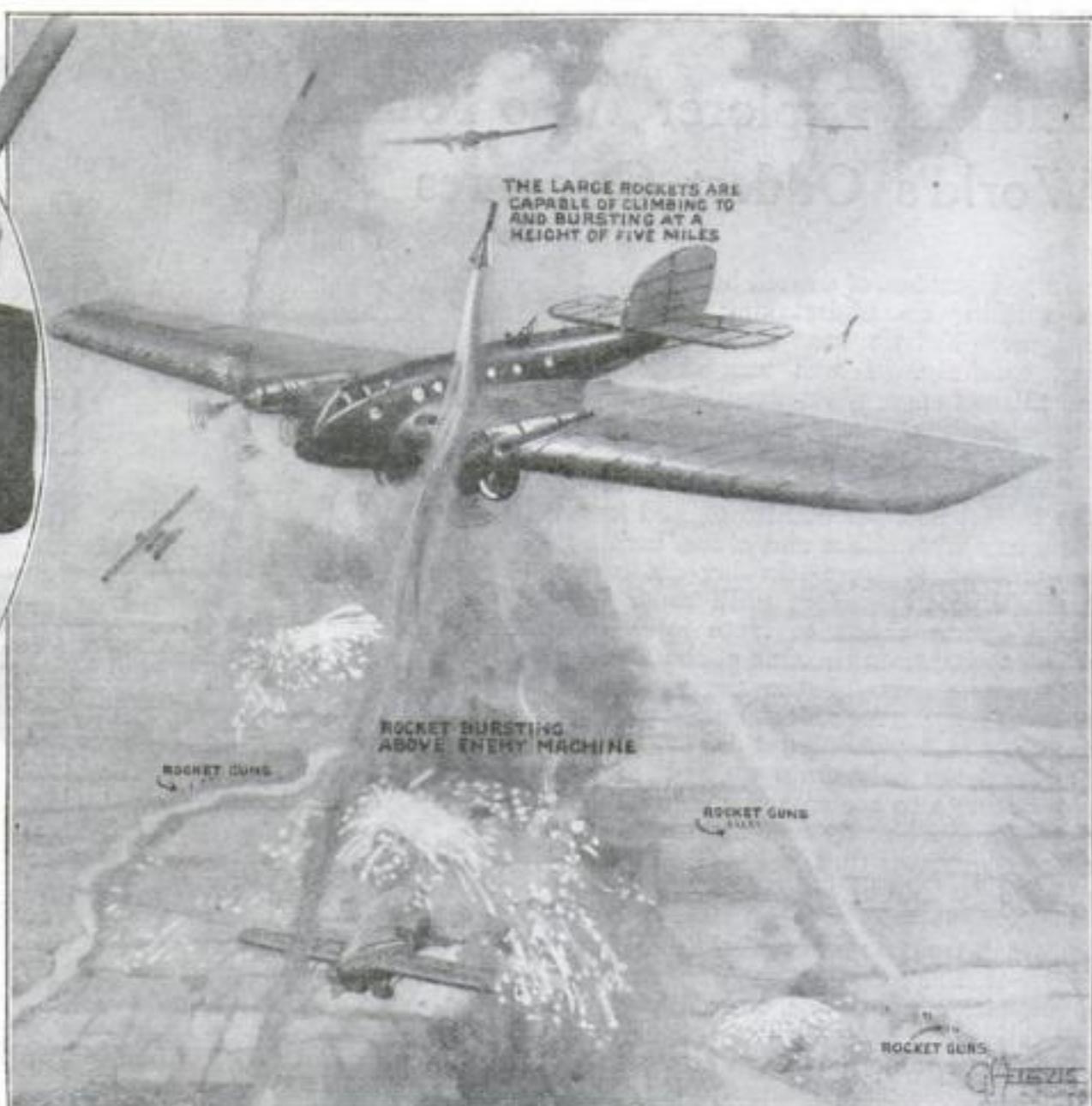
Death Rocket Rains Fiery Metal

A Terrific New Weapon of Defense against Air Attacks



© U. & U.

The new death-dealing rocket in the hands of its inventor, Ernest Welsh, of East Yorkshire, England. In place of the stick commonly used at the base of rockets are three vanes carefully made and adjusted to insure accurate flight. Mr. Welsh claims that the rocket, propelled by successive charges, can climb to a height of five miles



Our artist's conception of how batteries of the rockets might be used effectively by the defenders of a besieged city to throw up a heavy barrage of flaming metal against attacking air forces

How a Rocket Barrage Might Shower Molten Destruction in the Sky

RIVALING the widely discussed "death ray" of H. Grindell-Matthews, a terrific new weapon of offensive and defensive warfare recently has been developed in the form of a "death rocket" designed to throw out a flaming shower of molten metal miles above the earth's surface. The inventor is Ernest Welsh of North Ferriby, East Yorkshire, England.

From demonstrations and descriptions of the new war machine by Mr. Welsh, our artist has drawn the dramatic picture above, showing how the defenders of a city might repel an attack from the air by raining flaming molten pellets on the invaders. The inventor's recent experiments with medium-sized rockets is said to have proved that

each shower, bursting high in the air, can cover an area of 100 square yards, and can ignite any object within that region. The experimental rockets, it is claimed, can climb to a height of five miles.

The rocket contains a destructive charge of 700 pellets, a regulating charge, a detonator, and a propelling charge. When it is to be sent aloft, it rests in a diagonal launching cradle, somewhat similar to those used for ordinary sky-rockets. When the fuse is ignited, the propelling charge sends the rocket soaring out of its cradle. Thereafter, at regular intervals, it is given fresh impetus by the bursting of additional successive charges.

FOR use as defense against raiding aircraft, the inventor says that batteries of the rockets could be shot upward in the form of a barrage. The pellets quickly burn themselves out, he adds, so that the rockets could be used over a city.

Mr. Welsh is at work on a modification of the same weapon that can be fired from airplanes or airships, falling about 300 feet before bursting.



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Science Ousts River Stevedores

Mighty Mississippi "Comes Back" as Trade Route

MECHANICAL science is eliminating one of America's most picturesque institutions, the negro stevedore of the Mississippi River packets. No longer will he stagger under heavy loads, singing or shouting while he trudges up the stage plank to the deck of the stern-wheeler.

Instead, monstrous steel cranes, recently installed at several of the river towns, silently will swing great loads of freight through the air from concrete docks into modern low-lying steel barges. And silent towboats, propelled by Diesel engines, pulling long lines of steel barges in their wake, have sounded the doom of the historic river steamboats.

FOR Uncle Sam has gone into the freight business on the "Father of Waters" and engineers have constructed the first river boat to be propelled by a Diesel engine. Mammoth terminals have been constructed at Cairo, Ill., New Orleans, La., and points between, and hundreds of thousands of tons of freight now travel up and down the Mississippi each month. By means of the electric cranes and towboats, freight is now moving from Chicago to New Orleans in seven days, a faster gait than that ordinarily maintained by freight trains. And the freight is being moved at less cost, according to rivermen.

The new towboat that will take the place of the old side- or stern-wheel steam packet is economical and efficient. It has a steel hull and a complete steel main deck with a wooden superstructure. Her bow is constructed on model rather than scow lines and she is steered by three balanced rudders, each 18 feet long. The boat is 113 feet over all, has a beam of 26 feet and a mean draft of three feet. Her speed is about $12\frac{1}{2}$ miles an hour.

engine room and ballast tanks for trim are fitted forward. The Diesel-type boat shows a great saving in fueling over the steamer type in that the Diesel requires only 30 minutes fueling time every three months, while the steamboat requires

accomplished with half the power and also, if necessary, the boat can be operated with one engine.

A striking feature of these engines is the absence of outside shafting, cams and valve gear so noticeable on Diesel engines generally.

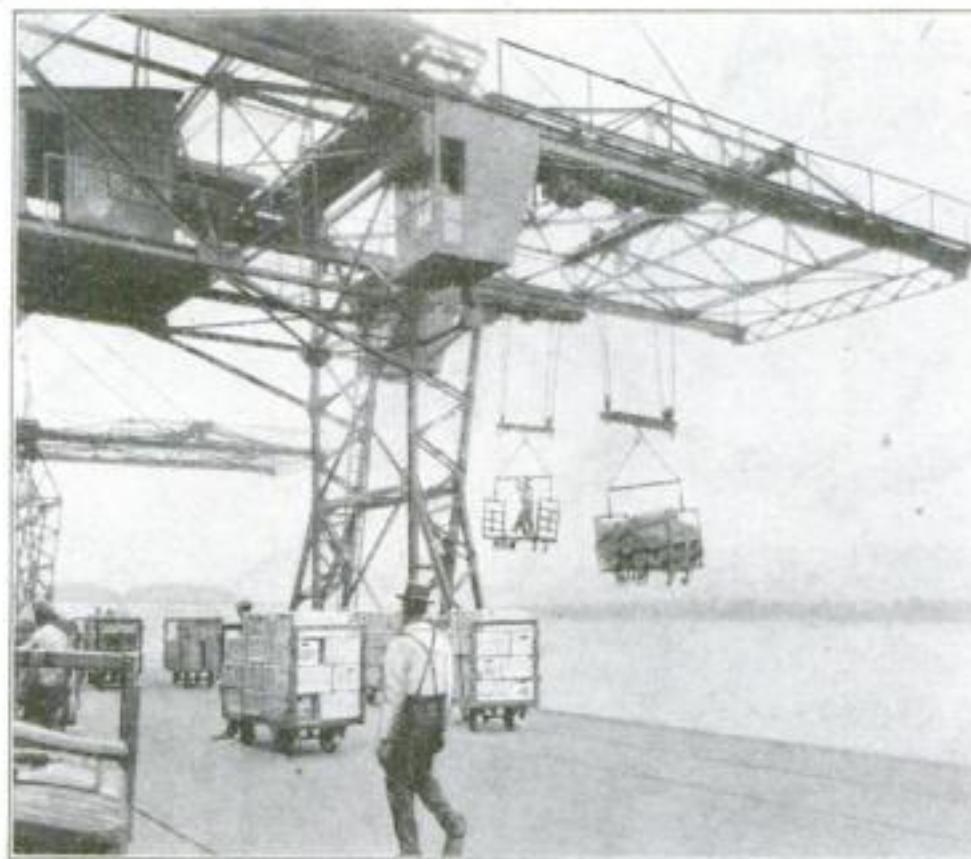
TOWBOATS are used for pulling strings of barges covering an area as large as 10 acres. Gigantic electric cranes and derricks now load and unload the barges, doing the work that formerly devolved upon the deckhand and doing it far more expeditiously and economically.

Many of the leading shippers of the Middle West are now utilizing the river. The new floating terminal at Cairo, Ill., is the largest of its kind in the world and this port is now one of the busiest on the river. Tows from the steel mills along the Allegheny and Ohio rivers are transferred to the Mississippi River barges for movement to New Orleans and there loaded in ocean-going vessels for shipment to Africa, South America, and Asia. Print paper for the newspapers of Chicago, St. Louis, and Kansas City is coming by steamer to New Orleans from Norway

and thence up the Mississippi, at a large saving in freight charges.

Cargoes of 15,000 tons, equal to the capacity of 300 freight-cars, are now being transported in a single journey. Merchandise of all kinds is once more moving up and down the mighty river. The line that was established during the war to transport war supplies from Mid-Western cities to the Gulf is there to stay, and the mighty Mississippi has come back as a permanent carrier of freight after a comparative idleness of many years.

NEXT month—A vivid article portraying ingenious new scientific methods of detecting criminals and of solving the most baffling mysteries.

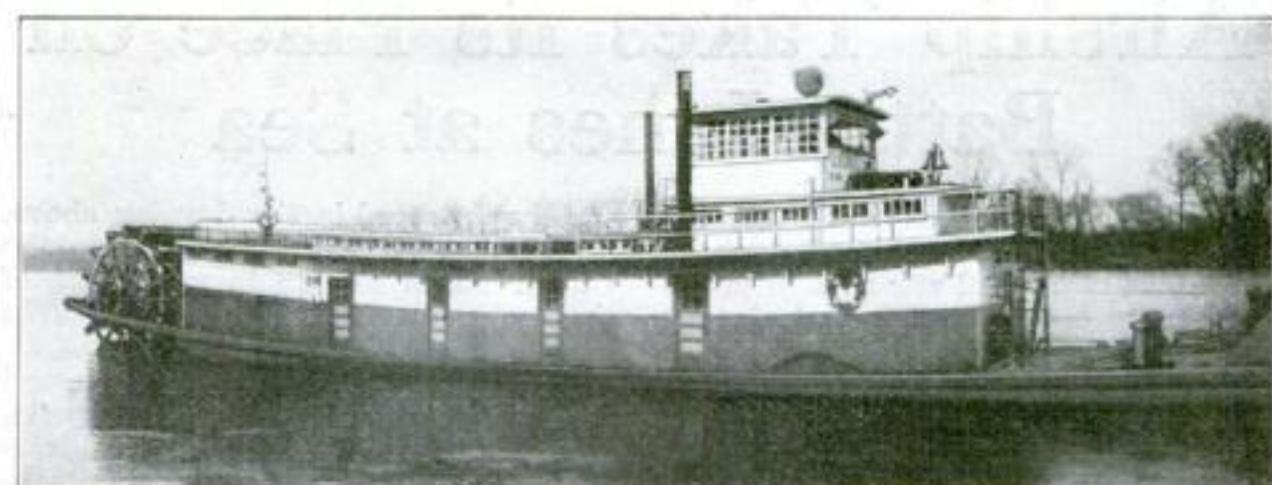


These huge electric cranes load and unload river barges expeditiously and economically in the transportation revival on the Mississippi River. Where lines of rollicking darkies formerly rolled individual barrels and boxes up the gangplanks of the old side-wheel packets, a man now sits in the control cab of a crane and mechanically shifts hundreds of tons of freight in a day

three hours a week and sometimes more.

The propelling machinery consists of two Diesel engines, four-cylinder, two-cycle, direct reversible marine type, of 120 horsepower each. Line shafts run aft from each engine to a point about 10 feet forward of the stern, where a sprocket wheel drives a roller chain. The chain, in turn, through a sprocket gear, drives a fore and aft outboard shaft, which, through bevel gears, operates the stern paddle wheel at about 19 turns a minute.

THE paddle wheel is divided in two parts so that the starboard engine drives the starboard portion and the port engine the port portion. By this arrangement, efficient maneuvering can be



A lineal descendant of the *Robert E. Lee*. This new Diesel-engined towboat, the first of its kind that was ever built for river work, pulls along a string of barges that would cover 10

acres. Cargoes of 15,000 tons, equal to the capacity of 300 freight-cars, and including merchandise of every form and description, trail this powerful craft up and down the river



C.W. Lounsbury

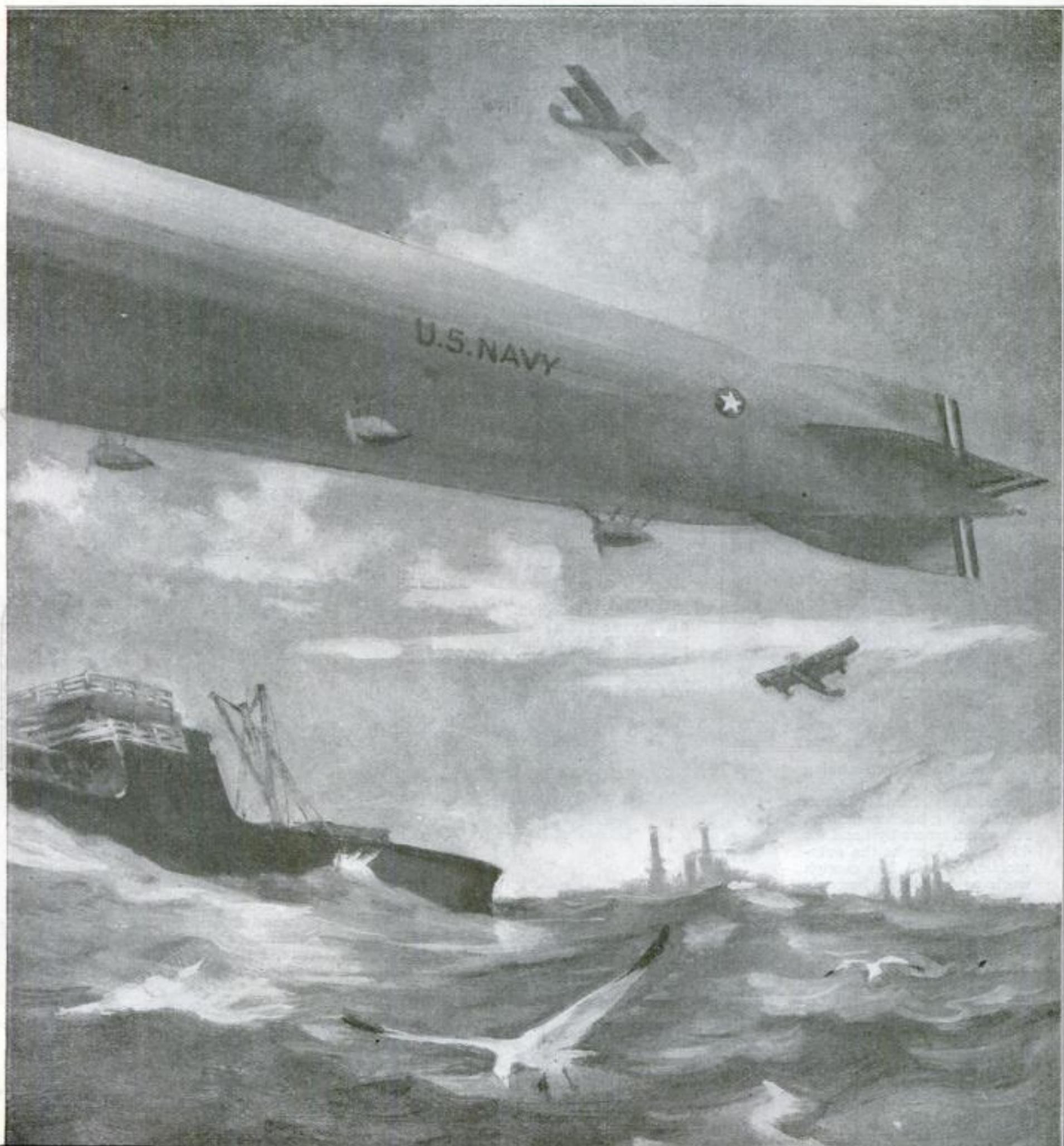
Airship Takes Its Place on Battle Lines at Sea

FOR the first time in history an airship functioned as an essential unit in a naval war fleet when the giant navy air cruiser *Shenandoah* took part in the recent maneuvers of the Atlantic Fleet off the New England coast. The most thrilling moment in the maneuvers undoubtedly came when the great dirigible hovered over Narragansett Bay, then fastened her silvery nose to the mooring mast that rose from the converted tanker *Patoka*, to float safely at anchor. This incident our artist has

vividly portrayed in the drawing above.

Soon the *Shenandoah* will cross the United States to join in maneuvers of the Pacific Fleet. There also the *Patoka* will be her base.

The *Shenandoah* has proved beyond question, in the opinion of naval experts, the capabilities of the dirigible as a weapon of war. Meanwhile, though, conclusive demonstration of the effectiveness of this type of aircraft for commercial purposes is being given by the air-liner, ZR-3, built in Germany for the United States



Leaders in Their Lines

Can You Beat the Records of These Craftsmen?



The title for harness-making is claimed by Archie S. Manning of Boston, Mass., who has been making bridles, saddles, reins, and traces by hand for 45 years. Despite the automobile, he still has enough work to keep him busy six days a week. He has made more harness for famous trotting horses, he claims, than any other worker in his line.



Kapriel M. Kazanjian, an Armenian, of Buffalo, N. Y., claims to be the only man in America who makes real Turkish cymbals



For 70 years Lorenzo Thurston, 87, has been cutting hay with this scythe he inherited from his father. He figures he has cut at least 2,000,000 pounds—more, he believes, than any one else.



Where Electricity Gives Up Its Magic

What I learned in a great research laboratory about the mightiest and most mysterious force ever harnessed by man—How wonderful new discoveries are being applied for the benefit of all of us—A remarkable interview with one of America's foremost pathfinders in electrical development

By Edward Mott Woolley

ELECTRICITY, until recently a vast mystery, is now at least partly revealed to us. We are able to penetrate its secrets in a way that proves that electricity itself is the basis of all matter, and therefore the foundation of science.

"Scientists have discovered that infinitesimal particle of electricity—the electron. We know that in their universe, so small we cannot conceive it, electrons are grouped about a nucleus. They revolve around this center much as the planets circle our sun.

"This minute solar system makes up an atom; atoms make up all matter. Now then, these discoveries, which have grown out of the wonderful work of Sir J. J. Thomson, may be taken today as the basis of all research that deals with matter, whether it be chemical or electrical. Indeed, it seems now that all the physiological reactions of life may be explained in terms of electrons.

"It is not much more than 20 years since the electron was discovered. For years it was regarded largely as a scientific plaything, without much practical application to industrial affairs. But chemists and other scientists began to understand the discovery in its true sense when the theory was advanced of the nucleus and the revolving electrons. We now know how many electrons are in an atom, and can measure and weigh them, and make charts of their groupings under varying chemical reactions."

In this way, Dr. W. R. Whitney, Director of the Research Laboratory of the General Electric Company at Schenectady, characterizes the modern era of electrical development.

I went to Schenectady to see Doctor Whitney and get a glimpse of his work. For 20-odd years the research department has been scouting into the unknown land of electricity. So many and marvelous have been the discoveries, that today the research work requires a five-story building, crowded with apparatus and strange

devices for exploring those elusive, clouded forces we speak of as "amperes," "volts," and other characteristics of electrical power.

Among the most wonderful is the X-ray device for determining the arrangement and grouping of atoms in metals and other solids. Here, too, you will find experiments in motion-picture photography, where exposures are made at the rate of 1500 a second—a single one in one millionth of a second.

happens that the discoveries are applied to the benefit of mankind.

"The research work of the General Electric Company," Doctor Whitney went on, "has reached into innumerable branches that may seem remote from electrical science. But somewhere such products as paints, oils, and varnishes, or such objects as flies, frogs, beetles, and chickens, work into our scheme. We may need to investigate the mica in the commutator of a railroad motor, the solder or insulation, or even its ventilation. We may dig into the atomic hydrogen in lamps or possibly delve into substitutes for rubber and platinum. We have done them all.

"How much light do laying hens like? Will they really stay up late at night, and is it a good scheme so to encourage them? Agricultural experiment stations have shown that hens without artificial light often involve a loss in winter. Under good electric light they produce a good profit in additional eggs, after all costs of light have been subtracted.

"We want to learn how to make the loudest possible noise at the least expense and send it under water. Again, we want to make the feeblest noise possible and still measure it. If this led to a noiseless New York subway, any one could appreciate it.

"Some of the most interesting phases of research may seem quite out of place in an electrical laboratory. You may wonder, for example, how biology fits at all into

Wealth Beyond Your Dreams in Nature's Storehouse

"THE development of research comes from daring to travel new roads," said Dr. W. R. Whitney, describing to Mr. Woolley his work as Director of the Research Laboratory of the General Electric Company.

"Instead of exhibiting pride at our accomplishments, we ought to register shame at our crass ignorance. Nature probably holds in store much greater things for man than he has realized or can anticipate.

"We have long known that we wanted cheap power. The sun sends us about one horsepower a yard of earth surface on a good day. Some time we must devise electrical means for catching and storing it.

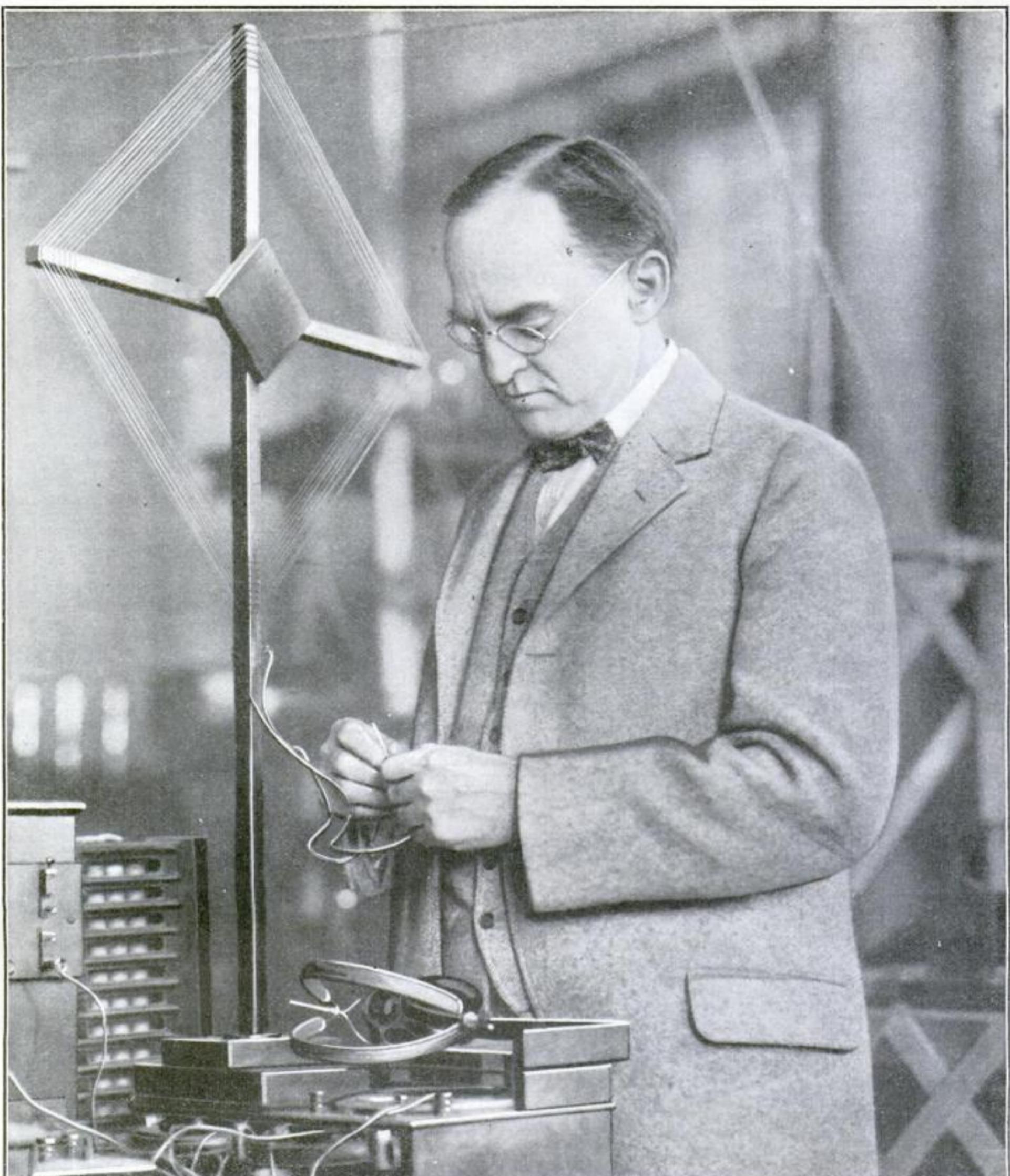
"There are probably in the offing many applications of electricity which we have not appreciated, but which at present cost can be made serviceable."

"One might ask, 'Why do this?'" said Doctor Whitney. "The fact that high-speed photography is being used for watching the very rapid vibrations of machine parts, as for example, turbine buckets, is sufficient reason. A metal may become fatigued if strained too much by vibrations. These can be found by very high-speed photography."

The work of the research laboratory is often done without a definite practical object, but usually with a scientific one, in view; but sooner or later it usually

electricity. Yet for several years Professor Mavor of Union College has carried on for this company experiments in heredity with the common fruit fly. This fly has a cycle of life lasting one month. During that time it passes through most of the physiological changes that in human beings require a normal lifetime. For that reason it is a good subject for observing the effect of X-rays on biological processes.

"Now as scientists, the workers in this laboratory should want to know the ef-



Dr. W. R. Whitney, who, in the Research Laboratory of the General Electric Company at Schenectady, N. Y., is directing the tireless work of prospecting unexplored fields of electrical usefulness. To him, "if a thing can be imagined, then somehow and some time that thing can be invented." Doctor Whitney was born 56 years ago at Jamestown, N. Y. After winning the degree of S. B. at the Massachusetts Institute of Technology at the age of 22, and a Ph.D. degree at the University of Leipzig, Germany, six years later, he became an assistant professor in the Massachusetts

school, until 1904. Since that time he has been the director of the research laboratory where he is now engaged in exploring the magic secrets of electricity. In addition, he has been a member of the U. S. Naval Consulting Board since 1915. He is a member of the National Research Council, the National Academy of Sciences, the American Institute of Mining and Metallurgical Engineers, and the American Institute of Electrical Engineers. He has won many high honors for his valuable work in adding to our knowledge about the mysterious and usable forces of nature.

fects of X-rays on growing organisms. We know the X-ray tube is a wonderful instrument for diagnosing many maladies; but when it comes to the matter of curing with the X-ray, I ask questions. We have far to go in experiment.

"The fruit flies are reared in bottles. Small groups and single pairs are placed

in separate bottles containing food, composed chiefly of fermented bananas. The breeding is done by selection. In carrying this out, a drop of ether is placed in one of the bottles with several hundred flies, and they remain unconscious for half an hour. They are examined under the microscope and exceptional ones

picked out. For example, those having red eyes or very small wings, or other abnormal characteristics, are segregated, and from these the breeding experiments are carried on, in many bottles—after the X-ray dose has been administered.

"Results show that the X-ray can mod-

ify the transmission of certain characteristics in the fruit fly. We are continuing these experiments, which certainly provide opportunity for interesting speculation upon the ultimate possibilities of the X-ray. We are not prepared, however, to reach any conclusions concerning the potentialities of X-rays and their curative relation to human beings."

IT IS known that in the nucleus of certain types of cells are formations called "chromosomes," resembling strings of beads, in pairs, lying close to each other and representing the hereditary traits of the parent flies. By analogy, the same beads in the human cell might contain the basis of mental or physical traits.

Let us suppose, for instance, that a given chromosome of one parent bears that mysterious power of transferring to the descendant cells, after fertilization, the faculty of good memory. Another chromosome may hold the secret of mathematical ability, musical genius, and so on, including such characteristics as the texture of the skin, color of the eyes, and tendencies toward defects as well.

Body cells multiply by dividing, but before this division takes place the strings of beads merge. When they separate, each string usually carries with it the characteristics of one particular parent, but since there are several pairs, and since the division is a random one—or, scientifically, obeys the law of probabilities—then the distribution of all the characteristics of the parents will be found in the offspring with the calculated mathematical regularity.

Doctor Whitney stressed the point that great inventions do not just happen by chance, but come from tireless research.

"Over there," he said,

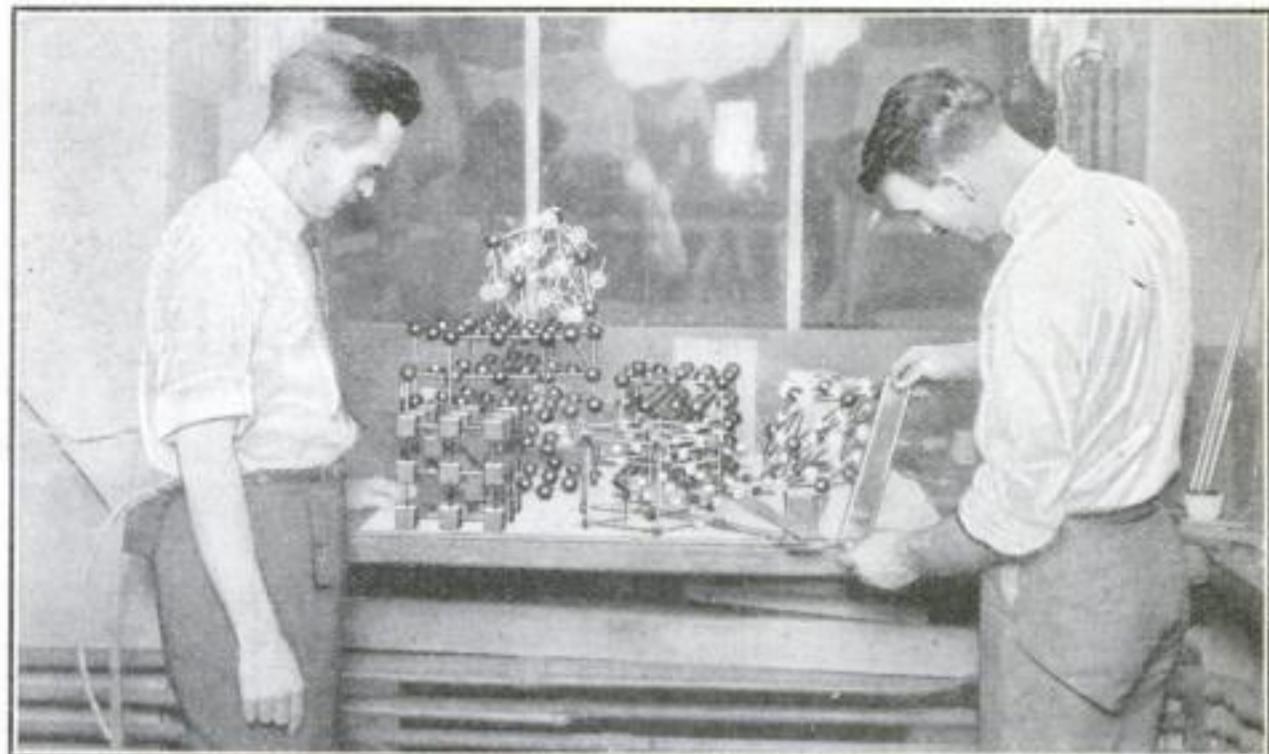


One of the most wonderful devices in the research laboratory is this X-ray spectroscope apparatus for studying the arrangement of atoms in solids, and determining their composition. On these studies are based the ingenious atomic models shown at the top of this page

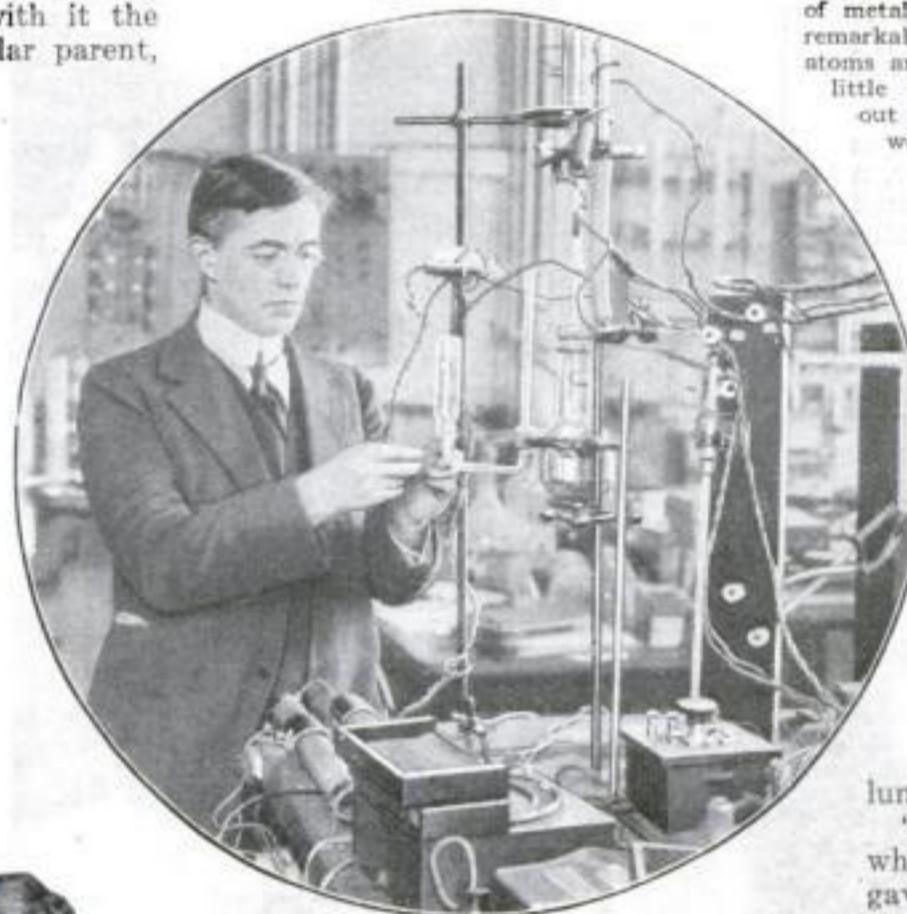
pointing to a scientist at a bench, "is a man who has spent 12 years working in what you might call 'black goo.' You might say that in all that time his hands never have been free from the messy stuff, in his efforts to improve the elec-

the method for making tungsten ductile—with revolutionary effect on the incandescent lamp—and the method of calo-
rizing steel.

Important developments in street lighting have come out of the laboratory. For



Varied groups of the atoms that make up the structure of metals and other solids are reproduced in the remarkable models shown above. Until recently atoms and the electrons that compose them were little more than "scientific playthings," without practical application. Today they are weighed, measured, counted, and charted



Dr. Irving Langmuir, noted assistant director of the General Electric Research Laboratory. He is the inventor of various electron tubes, as well as the widely used gas-filled incandescent lamp

trical brush for generators. Another has been at work just as long with mixtures of black gums, like tar and asphalt, but he has entirely changed the insulation of many kinds of electrical apparatus.

"And there is another man who has devoted himself exclusively for 19 years to glass tubes and to mere traces of gases in them; his delicate touch is seen in our gas-filled lamps and wireless tubes."

Conspicuous among the dramatic discoveries of recent years is the new X-ray apparatus devised by Dr. W. D. Coolidge, a distinguished associate of Doctor Whitney. Another work concerns the various electron tubes, and the gas-filled incandescent lamp invented by Dr. Irving Langmuir, also a noted associate in the laboratory. There also was the discovery of

example, the old arc lights were displaced by gas-filled tungsten lamps. Country roads now can be lighted cheaply.

"In the early days, all arc lamps were carbon arcs," Doctor Whitney said. "Through extensive research on the general properties of electric arcs it was possible to devise entirely new arc lamps. Instead of deriving the light from the hot arc of two carbon rods, the light now comes from a path of luminous vapor. In one case this arc consists of vaporized salts of the rare elements, such as cerium, and in the other the arc owes its luminosity to iron and titanium vapors.

"After finding that many substances, when vaporized by the electric current, gave more light than the old carbon arc, it was merely a question of choice of mixtures to give the color and intensity most desired. The mixtures now are quite carefully devised and controlled; but a particular iron ore, found along the eastern reaches of the St. Lawrence, almost exactly fits the requirements for the best arc lamps on the streets today. Such materials, after grinding and purification, are densely packed into thin iron tubes that take the place of the old arc carbons.

THE number of known metals has been doubled in the last few years by chemistry, and thus are made possible alloys not yet developed. Metallic calcium, for instance, was produced by electro-chemical research. No use was known for it—but important applications have been found. The same applies to magnesium; now we put it into our wireless tubes to preserve a quality of vacuum.

"The development of research comes
(Continued on page 155)

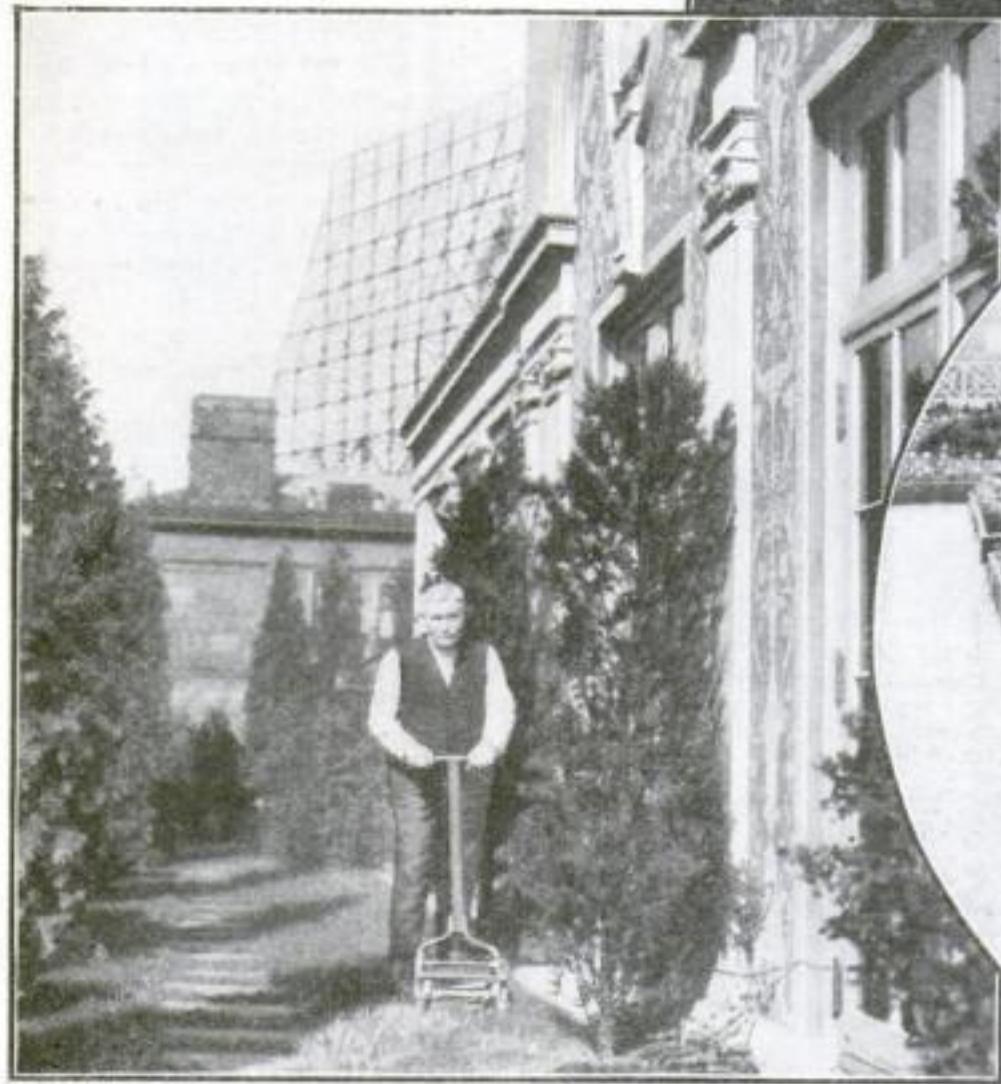
Country Gardens on Skyscrapers



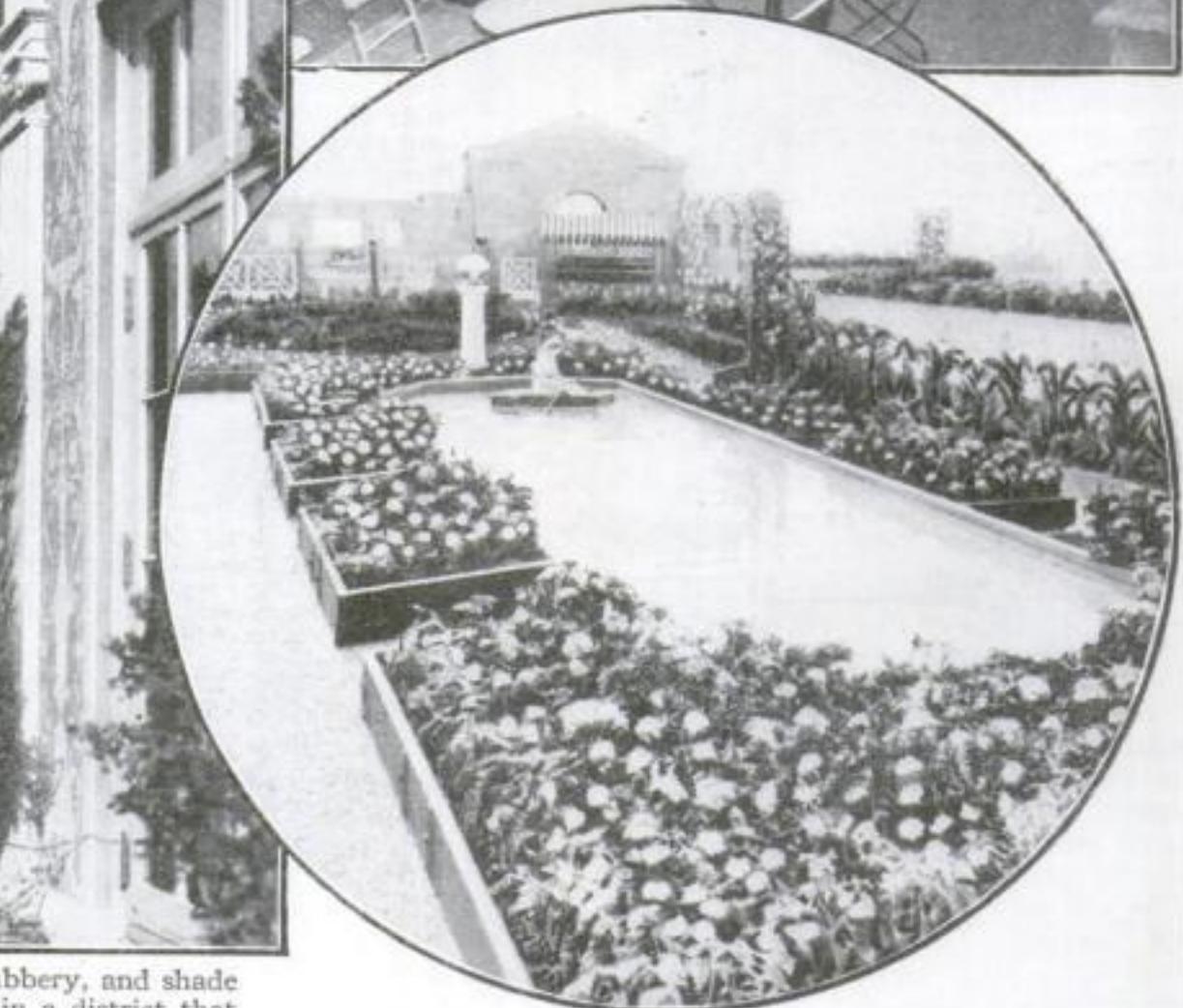
Being an architect, Herman Lee Meader overlooked no detail that might add to the beauty of his roof-top dwelling (above) on the Waldorf Building, in the heart of the fashionable shopping district. A picturesque Italian garden surrounds the house, a structure that would be an ornament to any modern suburban community

Luxurious Villas Built on the Roof-tops of New York's Business Buildings Permit Their Wealthy Occupants to Enjoy Delights of Suburban Life with all of the City Conveniences

Strictly speaking, R. M. Catts is not one of New York's modern cliff dwellers, for he occupies all of a handsome mansion in a fashionable residence district. The roof of his house, though, shown below, has been transformed into a gorgeous garden, containing rare plants and statuary. The great East River bridges, in the background, supply striking contrast



You would scarcely expect to find lawns, shrubbery, and shade trees several hundred feet above the ground in a district that is given over almost entirely to commerce. These, though, are only a few of the remarkable features that contribute to the beauty of C. K. Eagle's palatial skyscraper home. Set in a "valley" formed by the higher business buildings that surround it, this place nevertheless is high enough to spare its occupants annoyance from the noise and turmoil of the streets. His grounds and gardens are so extensive that he employs a gardener to care for them. Here is a surprising imitation of real suburban life, perched well above the crowded commerce of a city



Possibly the most complete of all New York skyscraper estates is that of E. W. Browning, which occupies the roof of an apartment building. Mr. Browning not only has flower and vegetable gardens and a 20-room house, but a lake large enough to permit both bathing and boating. Note the small rowboat on the flower-banked lake. Would you believe that such an outdoor paradise existed in the heart of a great metropolis, or that such seclusion from the rush of traffic could be possible?

Are Women as Smart as Men?

What recent investigations show—Expert opinions on a subject of universal discussion—Women whose wits have made them famous—An interesting way to test yourself and see how you compare with your wife in brain power

By James D. Weinland

IN A few weeks, between nine and ten million American women will go to the polls and help elect a President of the United States. Already women have played a part in the selection of the man who will be our chief executive for the next four years, for women delegates were a potent force in the recent national party conventions.

And, in addition to voting for a President, women in most parts of the country will cast ballots, if they wish, for other women who are seeking political offices, ranging from relatively humble municipal posts to seats in Congress—even, in the case of Texas, to the governorship of a state.

Already there is one woman in Congress—Mrs. Mae E. Nolan, of California—and two others have taken their seats in the national legislative halls since women were granted the right of suffrage. The present year finds 84 women as members of state legislatures. Several cities and towns have elected women mayors in the last few years, and women as members of city councils and similar bodies long since have ceased to appear as curiosities.

TO ME these facts seem to have considerable bearing on a debate that has been in progress through the ages—whether Adam, when he exchanged his rib for a woman, made a good bargain. Many

points in that controversy have remained unsettled, but in one particular there is, and always has been, surprisingly little divergence of opinion: the vast majority of men, no matter how much they may esteem and respect their mothers, their wives and their sisters, are quite certain that women have "no brains"; this, despite all the Madame Curies and the Hetty Greens and the George Eliots and the Clara Bartons of history.

This conviction of superiority in mental endowment seems to be inherent in every man. Bill Smith does not hesitate to offer the benefit of his "expert" advice to his wife on any subject, even in matters such as housekeeping or the care of children. And there probably ensues a

—just as much, or as many, as he; maybe more. Psychology says so, and psychology doesn't guess, nor approximate, nor generalize.

Recently psychology has got right down to cases and measured both men and women scientifically with the same yardstick, and reported that Bill Smith and his wife Mary are just about equal in intelligence.

VERY elaborate intelligence tests were given at Colorado College to 115 men and 111 women. The average score for both men and women was exactly the same—142 points. A combined study of the student bodies of the University of Idaho, University of Minnesota, Southern Methodist University and Colorado College, involving 3175 men and 1575 women, show that the percentage getting "A" and "B" grades in their studies was for men, 75.4, and for women 75.2.

In a joint psychological test of men students of Harvard University and women students of Radcliffe College a few months ago, a man and a girl tied for first place with an average of 86 per cent. A Harvard student made the lowest score of 8 per cent, while the lowest average for the women was 28 per cent. For the men the average was 50.5, while for the women it was 55.

There rarely appears any appreciable difference between male and female students, taking

The person reading the story should score you as you retell it. Every time you express an idea sectioned off between the little lines, you get one point. Sixteen points can be earned in this way. Four additional points are given if the essential theme, "dragged the pig out of the mud, and took a pain out of his mind," is given. Whenever an idea not expressed but implied in the original story is given, it is not counted against you, unless two such implications occur, when one point is taken from your total score. A perfect score would be 20; a good score, anything above 15.

lively family row if Mrs. Smith dares to suggest that he doesn't know what he is talking about.

For Bill Smith always has "more brains" than his wife—or any other woman! Moreover, he can "prove" it. He'll cite you instance after instance in support of his contention. The trouble is, though, that about nine times out of ten Bill's arguing is specious. In fact, Bill Smith is all wrong. His wife has "brains"

them all the way from kindergarten through college. Neither will you find any considerable difference in the quality of the output of men and women performing tasks that lie within the capabilities of each.

I TAKE down a copy of "Who's Who in America," biographical dictionary of notable men and women of the United States. If men and women possess approximately equal ability on the average,



© U. & U.

A woman who has made her way in science is Miss Aimee Potter of the U. S. Bureau of Entomology. Looking through a microscope, she paints delicately detailed portraits of insects in color

this volume should list many women as "notables"—not so many as men, of course, because only in recent years have women generally been following careers that bring them into the public eye. Opening the book at random, I find Maria Hornor Lansdale, author; Marion Florence Lansing, author; Marquise Clara Lanza, author; Augusta Larned, author; Linda Hull Larned, household economist; Mary August LaSalle, author; Hulda Lashanska, lyric soprano, Loula Davis Lasker, social worker—almost a dozen women listed as "notables" on a couple of pages!

THIS equality of men and women, however, does not mean similarity. They are complements rather than duplicates. There are important differences between the two sexes—social and biological.

Professor Edward Lee Thorndike, the famous educational psychologist of Columbia University, has classified the specific differences in the mentality of the sexes. Women, he says, excel in spelling, English, foreign languages, immediate memory and retentiveness. Men, he says, take the forefront in history, ingenuity, physics, chemistry and accuracy of movement.

I once was present while a noted scientist was preparing a paper. Every now and then he would look up from his work and ask how to spell "receivership," "stupefy,"

"battalion," or some other "sticker." His daughter, 13 years old, in her first year in high school, answered unhesitatingly, though regarding him with a look that denoted her wonderment that any one should be thought so wise and still know so little.

Bill Smith rarely remembers birthdays, wedding anniversaries, and the dates of other important events in the family history. Nor can he recall in what part of the house he left his umbrella after the last rainy day. But does his wife forget? Never!

It is not surprising, in view of woman's natural talent for language, that 39 per cent of the eminent women of the whole world have won their fame through literature. Virtually all of England's famous women have been writers. France has furnished women writers, and actresses and politicians, too. Italy and Germany have added musicians to this list, and the United States, reformers. There are many other occupations represented, of course, but these are in the largest proportions. What women are doing in politics in the United States we know.

IT IS only recently that women discovered science as a possible career. From the United States Bureau of Census, I learn that the number of women in chemistry and metallurgy has more than trebled in the last 10 years.

Similarly, the census returns show that there are now more than 2000 women draftsmen in this country, where 10 years ago there were but a scant 400.

In the same time the number of women college presidents and professors has increased from less than 3000 to more than 10,000. With about 1800 women lawyers and judges, we now have more than three times as many as there were a decade ago. We find more than 4000 women bank officials, almost as many women officials in manufacturing enterprises; women doctors, dentists, and clergymen in legion. There are even 1000 women who earn their livings as chauffeurs, compared with 33 only 10 years ago!

This information is significant. Does it indicate that psychology in the past found women "ineffective" in such fields merely because their past training and opportunities had not directed their interest to them?

Once women were thought to be less intelligent than men because their brains are smaller. Then psychologists learned that it is not the size of the brain that determines its quality, but the number of brain cells it holds, and that often a small brain has many more cells than a large one.

WHEN Bill Smith accuses his wife of having "no brains," what he really means is that she has emotional and temperamental qualities different from his own. These qualities are evasive and hard to measure. Women, Professor Thorndike finds, are strong in emotionality, temperance, impulsiveness, religiousness, sympathy, patience, vanity, and shyness. Men, on the other hand, he finds strong in temper, self-consciousness, humor, independence and pugnacity. He means, of course, the average man and the average woman, for you'll find some men more interested in babies than some women are; some women more self-assertive and ag-

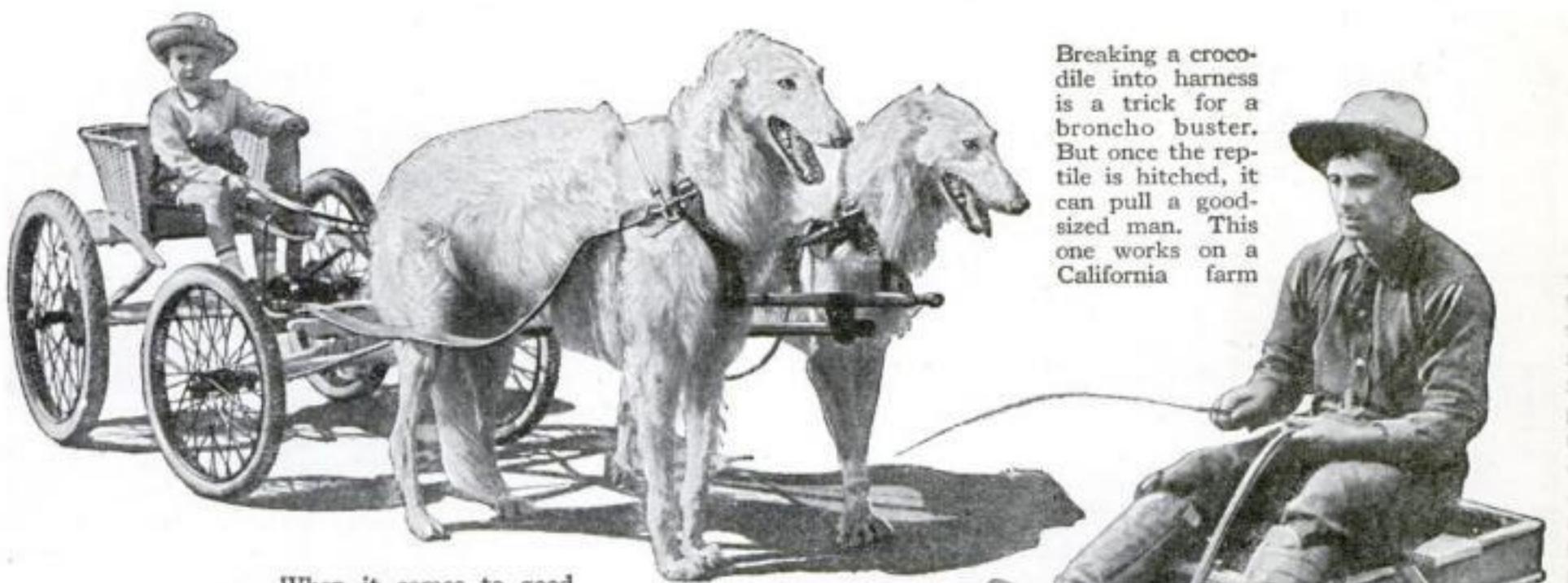
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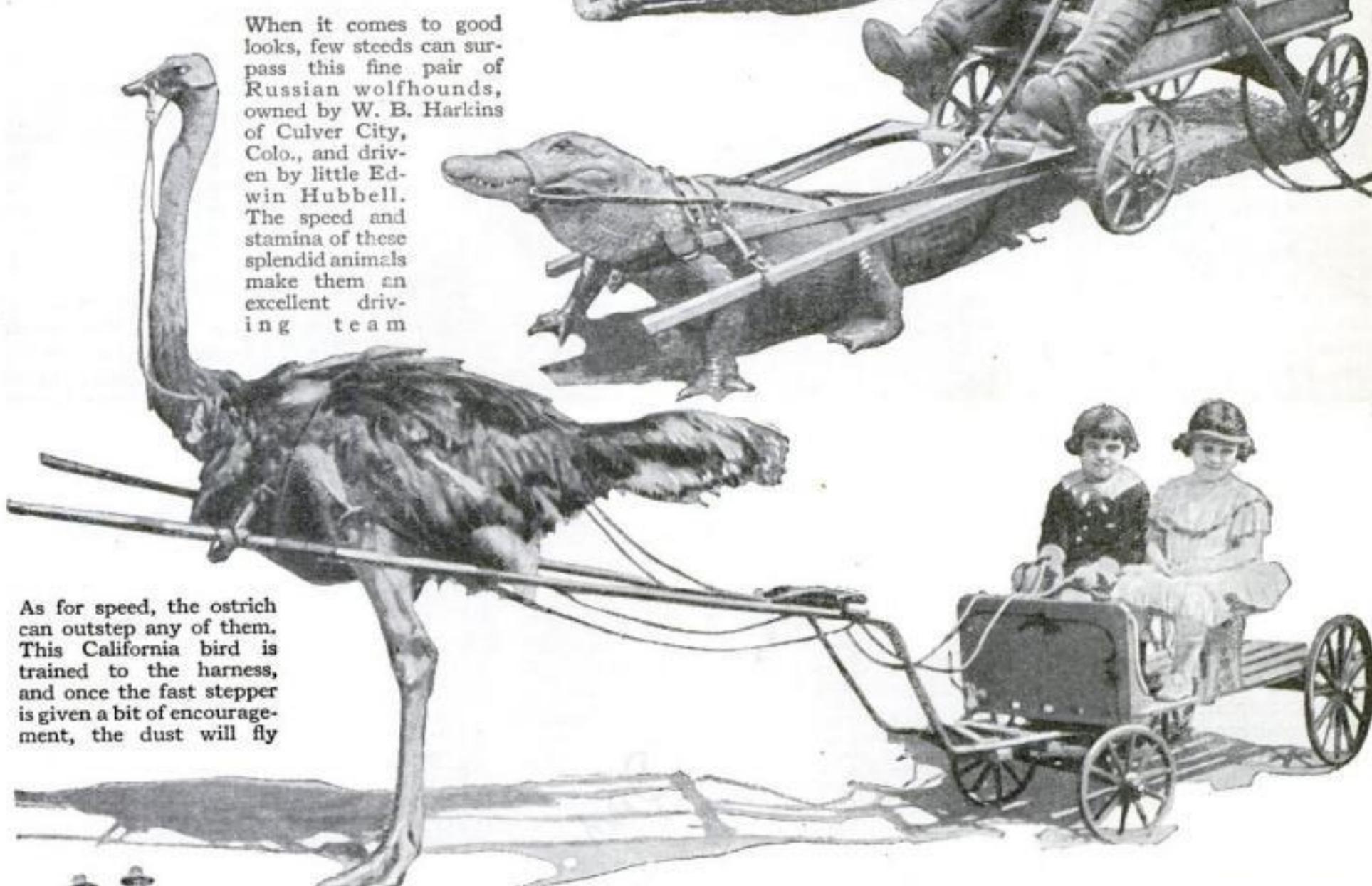
Two striking examples of the increasingly important part women are playing in government affairs. Born and educated in California, Mrs. Nolan, a Republican, went to Congress in September, 1923, to fill the unexpired term of her husband. She now is serving her second term—the only woman in Congress. Miss Robertson, a daughter of missionary parents and descended from pioneer American stock, served as a Republican member of the Sixty-Seventh Congress from 1921-23. Before entering politics she won the degree of LL.D., at the University of Tulsa, Okla., served in the Indian Office at Washington, D. C., engaged in missionary and educational work among the Indians, served as a post-mistress under President Roosevelt by personal appointment, and later owned a dairy and cafeteria. How many men do you know who can beat these records in their versatility of achievement?

Strange Beasts of Burden

How Would You Like to Drive a Crocodile or an Ostrich?



Breaking a crocodile into harness is a trick for a broncho buster. But once the reptile is hitched, it can pull a good-sized man. This one works on a California farm



As for speed, the ostrich can outstep any of them. This California bird is trained to the harness, and once the fast stepper is given a bit of encouragement, the dust will fly



No doubt you have ridden behind a lone billy-goat, but did you ever try to drive a five-team span of them and make them all go in the same direction? These goats are not out for pleasure. They do much of the light hauling on a large Australian farm

In his slow, easy-going way, the camel is a genius for work. Usually he prefers to carry his burden on his back; but here you see him between the shafts of a small Egyptian cart that he pulls along in an always leisurely but tireless manner



© Keystone

Who Says the Weather Man Is Always Wrong?

He's right eight times out of ten, the records show—How Uncle Sam's Weather Bureau serves you and safeguards the nation's lives and property—A dramatic story of the man who began by flying kites and who now directs this service

By Norman C. McLoud

"**F**AIR and slightly cooler today; showers tomorrow."

I read that in the weather bulletin in my newspaper the other morning, as did millions of other Americans, and congratulated myself that I was to have a pleasant day for an important conference. For I was on my way to see Dr. Charles Frederick Marvin, chief of the United States Weather Bureau — a man who renders you and me daily service, an important service, which has become so much a part of our lives that we take it for granted, with never a thought to the great organization that gives it to us, or the man who directs it. And I was about to learn what is behind the little weather forecasts we all read first on picking up our papers.

BRIEFLY, Marvin himself is behind them. The story of Marvin is the story of the Weather Bureau. They are inseparable. He wouldn't talk about himself, but he was willing to talk about the weather and the bureau. That's how I learned many things about Marvin; interesting things that affect all of us.

Marvin took me on a tour of the country. We traveled on maps. No railroad conductor was ever more at home on his regular train than was this scientist on his weather charts. He makes them, and he knows them thoroughly. He made me feel at home, even in the highest atmosphere.

I never have been up in an airplane, but with Marvin I crossed the country on the wings of a storm. He explained to

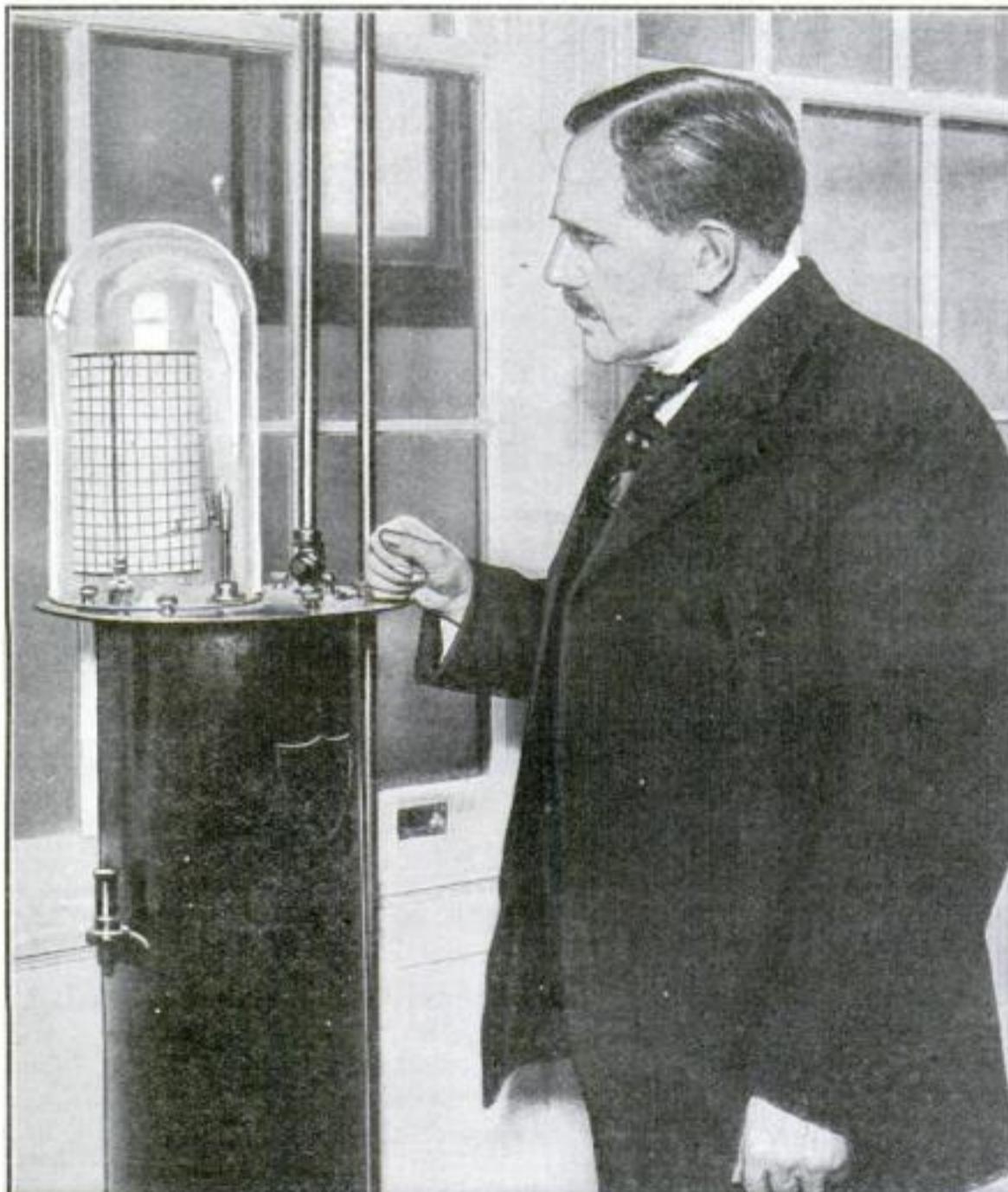
me the general trend of American storms. Broadly speaking, they move from west to east. This motion is connected with the rotation of the earth, which is in the same direction. He told me, however, that this rule is not inflexible. At times

lay more stress on an error than on good performance. And he has good reason for consolation in the fact that his records show the weather man to be 80 per cent correct in his forecasts. In other words, eight out of ten of his predictions are accurate.

As an inventor of weather instruments, Marvin attained international reputation before he became head of the Weather Bureau. His success in making mechanical apparatus for the bureau had much to do with his selection.

IN BOYHOOD he had found fascination in kites. I am told that he was a kite-flier of parts and that his creations were the envy of his playmates in Ohio. When kite-flying became a scientific task for study of the upper air, the matured instrument-maker applied the knack of his boyhood. As a result, he evolved the weather kite, a boxlike structure that carries recording instruments high in the air, until it is today one of the most important agencies of meteorological observation.

Improvement of the kite was merely a starting point. As a boy, Marvin had learned the difficulties of winding and unwinding the string with which kites are held in leash. With the weather kite a new problem was presented. A boy flies his kite with a string known to him as "hardware twine." Science must use a fine steel piano wire. Every boy who has let the cord slip through his hands knows what hardware twine can do in the matter of burns. He realized, too, that piano wire would be a thousand times worse.



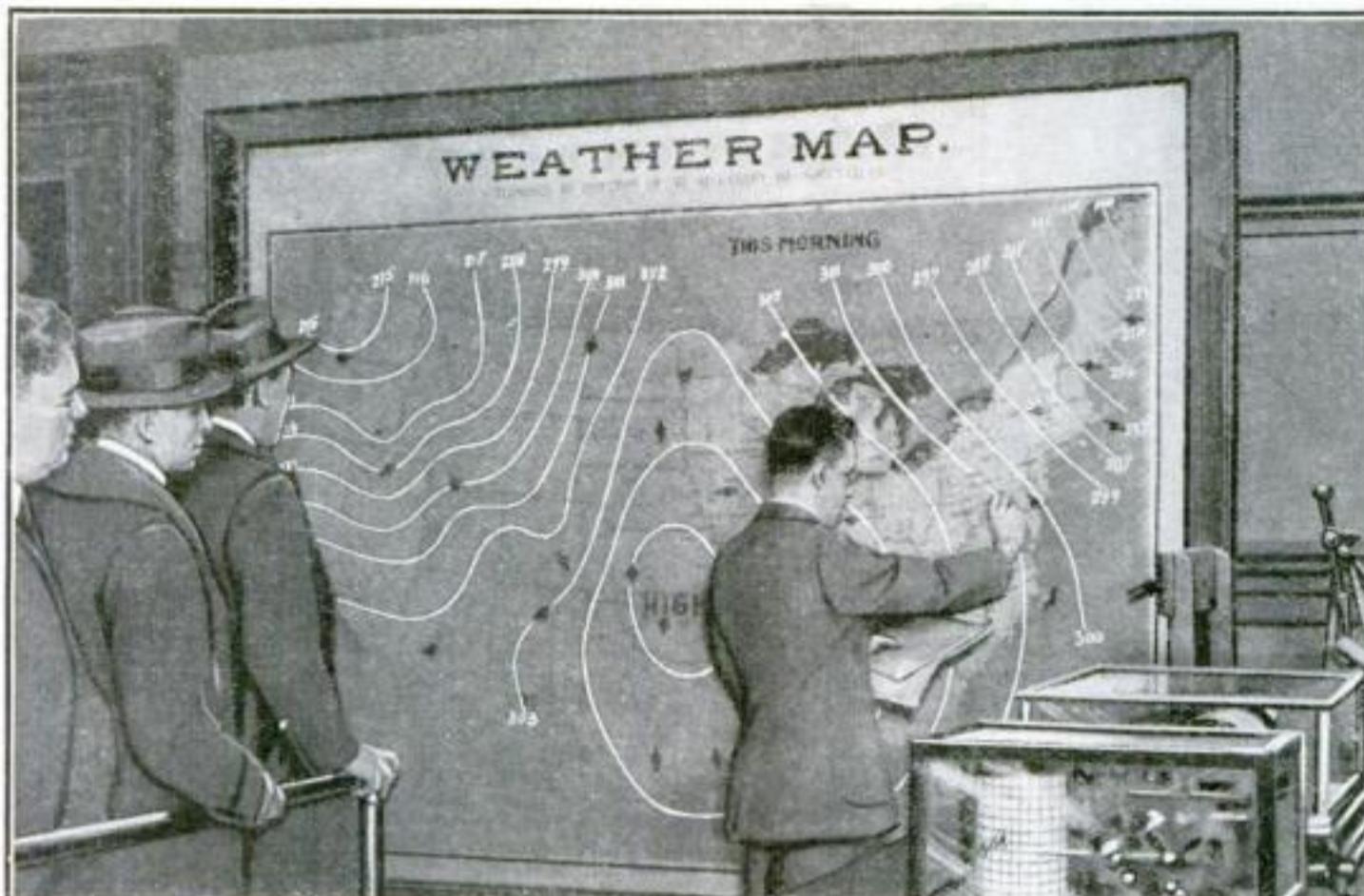
Dr. Charles Frederick Marvin, Chief of the U. S. Weather Bureau, with his improved weekly rain gage that makes automatic

records of rainfall over long periods. This is only one of many instruments perfected by Doctor Marvin to render daily service to you

storms are deflected from their courses by influences not always apparent, a fact that accounts for the occasional failure of rains and blizzards to arrive as predicted.

These occasions, incidentally, have given rise to the loose but often repeated statement that the weather man always is wrong. Marvin is tolerant of "weather-man jokes," for he knows it is human to

hold in leash. With the weather kite a new problem was presented. A boy flies his kite with a string known to him as "hardware twine." Science must use a fine steel piano wire. Every boy who has let the cord slip through his hands knows what hardware twine can do in the matter of burns. He realized, too, that piano wire would be a thousand times worse.



Making a daily weather map at one of the Weather Bureau's observation stations. Similar maps prepared every day in all sections of the country are the basis for the little weather forecasts you read in your paper. Varying degrees of atmospheric pressure throughout

the United States, reported by wire from each station, are charted on the map. From a study of the high- and low-pressure areas, the observer can tell the location and direction of storms with amazing accuracy, and so give warnings in time for precautionary measures

There would be no holding the smooth strand.

"The wire had to be wound on a drum," Marvin told me, when I insisted on hearing more about his work. "This made it necessary to develop reeling apparatus. It fell to my lot to devise this piece of mechanism—a small outfit operated by an electric motor. The result was satisfactory and the reel now is in constant use.

FURTHER work brought the kite meteorograph, an instrument that records conditions in the upper air currents. It was important that records brought back from the upper regions should be as complete as any similar records obtained on earth. This meant that the kite must tell us the story of wind velocity, temperature, atmospheric pressure, and humidity in the upper regions. The meteorograph now brings this information as completely as if an observer were aloft with the kite. With a series of pens, the instrument takes dictation from the elements and writes it with scientific accuracy on an endless sheet of paper."

The kites work in conjunction with balloons of the Weather Service. Kite observations are confined to what the meteorologists know as the lower layers of atmosphere, although they sometimes go as high as 4 1/3 miles. Captive balloons are used in similar areas when there are light winds or none at all. Sounding balloons are sent to heights of 20 miles and bring similar information from the upper air layers. With each of these three agencies Marvin's meteorograph is used.

A fourth agency is the pilot balloon, which sails away into the upper air and never comes back. Once free, the sphere moves upward at uniform speed and is carried along by the wind. The record of its flight is made by an observer on the ground, who watches its movements through a theodolite—a telescope so

mounted that the operator can determine vertical and horizontal movements of the balloon with mathematical accuracy as to speed and distance. These observations determine wind velocities at various heights.

Recital of Marvin's inventions may appear to suggest a "What's What of Meteorological Apparatus." Take, for instance, the snow and rain gages that give us daily information about precipitation. Marvin designed them so that they make automatic records of rainfall and snowfall with perfect accuracy, no matter how hard the wind is blowing.

BUT of what practical value are these instruments of Marvin's to you—in your business and in your home?

The truth is that every day they render real, personal service to practically every person in the country. For the safety of lives and cargoes, at sea, for example, reliable weather forecasts and storm warnings are indispensable. In recent years there has been hardly a storm of marked danger to maritime interests without ample warnings being issued from 12 to 24 hours in advance. Sailings of the vast fleets of vessels engaged in our ocean and lake traffic are largely guided by these warnings, with immense saving of life and property. Warnings displayed for a single

hurricane are known to have detained in Atlantic ports vessels and cargoes valued at more than \$30,000,000.

Similarly, predictions of approaching cold waves, issued from 24 to 36 hours in advance, have resulted in enormous savings in our food supplies. They make possible the adequate protection of fruits and vegetables in transit. Shipments that cannot be protected can be deferred or accelerated. Moreover, daily forecasts and reports of general weather conditions assist in maintaining an adequate flow of perishable products to meet irregular demands dependent upon the state of the weather.

THE average city dweller has little conception of the part in his daily comfort and security played by Marvin and his weather forecasts. The number of uses made of temperature forecasts in crowded centers of population is surprising. With the prediction of an imminent

cold wave, greenhouses are closed and their boilers filled for action, with resultant saving in loss and damage to the tender plant growth. Fire-plugs, exposed mains, and general plumbing are protected. Gasoline engines are drained. Newspapers print fewer copies for street

(Continued on page 158)



This remarkable picture of a cyclone twister was taken in Nebraska. A whirling storm of this kind is capable of tremendous damage, for the funnel cloud probably revolves at a speed of at least 500 miles an hour. Usually it is followed by a deluge of rain. By giving warning of destructive storms, the Weather Bureau saves many lives and property of immense value every year in all parts of the country



Jagged Rock Spires Carved by the Rain

THE same forces of nature that sometimes dig unsightly gulleys in your yard during a heavy rain-storm, were the sculptors that carved the lofty, oddly shaped spires of rock shown above.

This remarkable photograph was taken recently at the edge of Crater Lake, a vast depression that once was the crater of an active volcano, in Crater Lake National Park of southwestern Oregon. Geologists who have studied it recently say it is the most striking illustration ever discovered of the tremendous power of rain in cutting away rock formations.

Ages ago, when this cavity was the

crater of an active volcano, they say, it threw forth vast masses of volcanic dust and lava fragments. Through the centuries, these consolidated into layers of rock. Near the top of the rock strata was formed a layer harder than the rest, visible in the photograph as the projecting ledge near the top of the cliff in the background.

It was this hard layer that made possible the formation of the strange rock pinnacles. For, as countless rainstorms beat down upon the crater, century after century, certain portions of the hard layer resisted. And wherever it resisted, it served as a shelter to protect the

softer rock that lay directly beneath it.

Meanwhile, where the rain broke through, it washed away the softer material, leaving the protected material standing in the form of rock-capped spires. You can see in the photograph the sloping piles of the softer material washed down the side of the crater.

THE process shown here on a spectacular scale is known as erosion. It is the process that slowly wears away the hills and mountains.

The next time it rains, go out into your garden or roadway. There you can see, on a small scale, how Nature carves.

What Radio Set Shall I Buy?

How to obtain the best results at the lowest cost—What you may expect from the various types of sets—Factors that should determine your choice—An expert of the Popular Science Institute of Standards offers you impartial advice

By Alexander Senauke, M.E.

WHEN you buy an automobile, you can use your pocketbook as your guide without fear of going very far wrong. Automobiles differ widely, of course, in such particulars as speed, appearance, and riding comfort; and yet the difference between cars is not very great insofar as general results are concerned. A small, cheap car will carry you any place an imported limousine will, not so quickly perhaps, nor in such comfort, but it will get you there, and that, after all, is the purpose of the automobile.

Buying a radio set, however, is quite a different matter. Though you reasonably can expect your \$500 automobile to carry you safely from New York to San Francisco, you mustn't expect to do transcontinental radio touring consistently with a \$25

quality of radio reception that it may be possible for you to get the best out of radio with a set costing \$50 or so, while a man living a few miles away obtains un-

I could go on almost indefinitely mentioning similar factors that might affect your choice of a radio set. For each man—anyway for each group in a particular locality—selecting a radio set is an individual problem. A sensible way of approaching this problem is through the experience of others. Before you buy your set, make a canvass of the radio fans of your immediate neighborhood. Find out what types of sets they are using and what sort of results they are getting. Listen to the sets if you can. Your local dealer, too, can help you, for undoubtedly he knows what sets work best in your locality.

But meanwhile, in order that you may be able to talk radio intelligently both to your dealer and to the friends to whom you may look for advice, let us examine a few of the common

How to Select a Radio Set

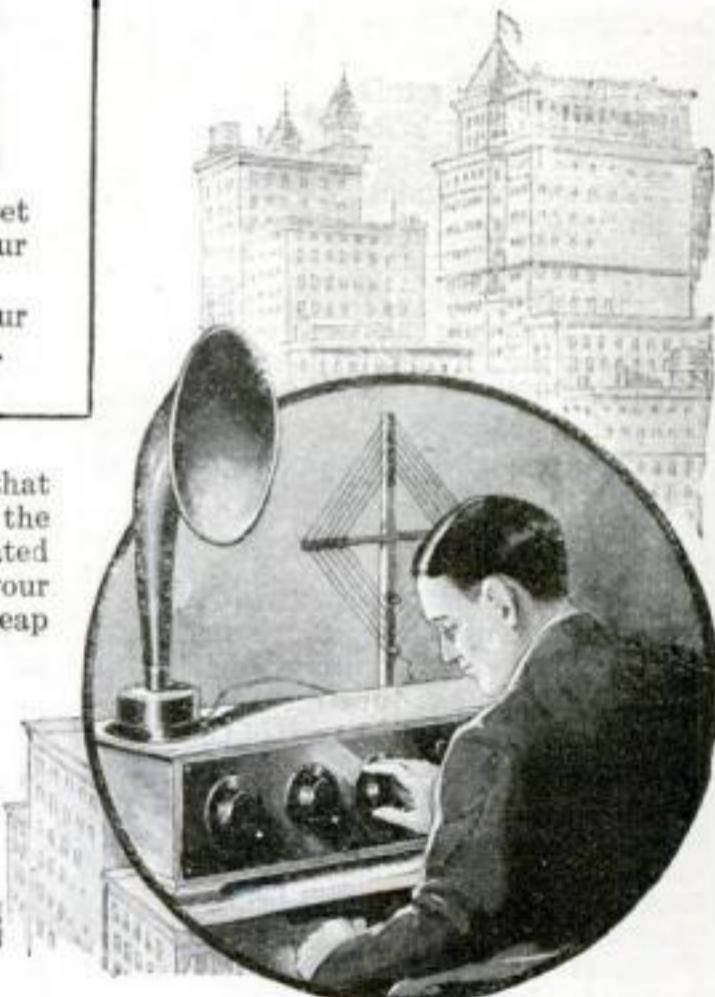
1. Write down the answers to the following questions:
- What is the power of your local broadcasting stations and how far from them do you live?
- What type building do you live in, what type are the surrounding buildings, and what kind of aerial will you use?
- What consistent distance range do you desire?
- Will you use head phones or loudspeaker, and, if the latter, do you want entertainment for a large audience?
- What quality do you desire in reproduction?
- Do you want a portable or stationary set; dry or storage batteries; plain or ornamental set?
- How much do you wish to spend?
2. Read this article and select the set that seems most nearly to fit your requirements.
3. Check up your selection with your local dealer or other radio expert.

satisfactory results with a receiver that cost three or four times as much. On the other hand, your home may be so situated that you would literally be throwing your money away if you were to buy a cheap set.

If you live on a lower floor of a city apartment house, for example, and are forced in consequence to receive on an indoor aerial, to obtain equal results you must buy a much better set than the one owned by the man around the corner who lives in his own house and can use a good outdoor antenna. A man living a few miles from a good broadcasting station, who is satisfied to listen only to the local programs, need not buy so large and expensive a set as his neighbor who wants to tune out the local programs and hear the broadcasting from other cities. The man who will "listen in" through head phones need not spend so much for his radio equipment as the man who wants his family to hear the broadcasting with a loudspeaker.

The luckiest radio fan possibly is the suburban dweller, who lives a few miles from a single good broadcasting station. He can enjoy the delights of radio with a simple crystal detector set, costing somewhere between \$10 and \$15

receiver. This doesn't mean, however, that to enjoy radio it is necessary to buy an expensive set. Such factors as the geographical location of your home and the type of building in which you live have such tremendous bearing on the



The city man, surrounded by steel buildings that absorb the energy of the radio waves, and forced to use an indoor aerial, rarely can obtain good results except with an expensive multi-tube set that is powerful and selective

types of radio receivers and see what each may be expected to accomplish. Among them you may find the set that fits your particular needs.

The cheapest and simplest radio receiver is the *crystal set*. You can buy a

crystal set complete for from about \$10 to \$15. It has one advantage over all other sets—your initial outlay for it is likewise your last, for it has no batteries, nor other parts to be replaced or renewed. Also, it gives clear reception, though the volume of the sounds it lets you hear is relatively weak. However, a crystal set has disadvantages that for the majority of people will far outweigh its merits. Its receiving range, except under extraordinary conditions, is not likely to be more than 25 miles, and most of the time probably will be no more than 10. It can be operated only with head phones, though more than one set of phones may be connected in at once. It requires a good outdoor aerial. But its principal disadvantage, even for those who are content to hear only local broadcasting, is that it is not selective.

IT IS virtually impossible to tune out one station and get another with most crystal sets. If you are close by two or more broadcasting stations and they are transmitting simultaneously—as they usually are, especially at night—you probably will hear them all at once, and the result will be confusion. The crystal set, generally speaking, is not the set for the city dweller, both because of this likelihood of *interference* and because absorption of incoming radio waves by steel buildings and many aerials probably will result in weak signals.

For the man living in the suburbs of a large city with a single broadcasting station—distant, say, from five to 10 miles—the crystal set supplies a cheap way of enjoying radio. For all others, though, it is likely to prove unsatisfactory.

IF YOU belong to that vast majority who would not be satisfied by a crystal set, yet still desire to enjoy radio at small cost, possibly a one-tube receiver will fill your needs. A common type of this set is what is known as the *single-circuit regenerative receiver*, which, exclusive of accessories, costs from \$15 to \$30.

Since a vacuum tube is used, this set requires batteries. It will bring in stations up to 100 miles away consistently by means of head phones, although under favorable conditions its range may be increased to 500 miles or more. The operation of this set is simple; a half-hour should suffice to teach any one to use it.

This set, however, is not particularly *selective*, which, as in the case of the crystal set, means that it is scarcely the receiver for the man who lives within a few miles of several broadcasting stations. Also, the owner of a *single-circuit regenerative receiver* is likely to become very unpopular with his neighbors, for the reason that his set causes *radiation*, which produces an-

noying howls in other receivers in the neighborhood. So I should say that unless you live in the country, with no other radio fans within a couple of miles of you, this type of set is not the one for you to buy.

A generally more satisfactory type of the one-tube set is what is called the *three-circuit regenerative receiver*. This has been a popular set since the early days of radio. It is rather difficult to operate, but it will give you excellent results as to *selectivity* and *sensitivity*. That is to say, you can tune out the stations you don't want to hear and receive signals from long distances. A receiver of this type costs from \$20 to \$35 and under favorable con-

ditions you should receive up to 1000 miles. These estimates are based on assumptions that an outdoor aerial is used; also that entertainment and not fragments of programs from distant stations is desired from the set.

THIS latter is a phase of radio that should be considered, no matter what kind of a set you buy. If you want entertainment, you will have to rely almost entirely on near-by stations. Distant reception is never clear. There is a thrill in hearing even a confused jumble of sounds from a station 1500 miles or so away, but the intrinsic beauty of the sounds is likely to be lost in transit. Except on very exceptional nights, no matter how fine a radio set you have, if you are far away from a broadcasting station, you will not hear so well as the man who lives near by.

It might be well to speak here of the so-called *reflex sets*. These are receivers in which vacuum tubes are made to do double duty. For example, the receiver might be so wired that after a tube had supplied radio-frequency amplification, the signals would be reflexed back to the same tube for audio-frequency

amplification. By use of the reflex principle, radio engineers have succeeded in increasing the efficiency of various types of sets by the equivalent of from one to three tubes, without actually adding tubes.

There is a one-tube reflex set, that employs a crystal detector, and, using a tube to supply radio- and audio-frequency amplification, permits the operation of a loudspeaker. Three-tube reflex sets may possess the same efficiency as four- and five-tube sets, and so on. So, when I speak of a four-tube set, say, as giving a certain performance, bear in mind, please, that the same performance might be given by a three-tube set employing the reflex principle.

BY WHAT might be called the *normal* arrangement of vacuum tubes in a four-tube set, one tube supplies radio-frequency amplification, one is used as a detector, and two are used for audio-frequency amplification. A set of this type costs from about \$60 to \$175, without accessories. It will permit a loudspeaker to be used for entertainment—even dancing—up to 200 miles, and, under favorable conditions, may give loudspeaker reception of fair clarity up to 1000 miles. Another type of four-tube

(Continued on page 160)



Every one of the sets on the shelves of this radio store is just the right set for somebody. Which is the right set for you? Probably, like the man in the picture, you would be puzzled if confronted by the necessity of making a selection. And yet,

picking out the right radio set, the writer of this unusual article shows, is exactly like picking out a hat or a pair of shoes—a matter of determining your requirements by a few simple rules. To enjoy radio thoroughly, your set must fit your needs

ditions will bring in broadcasting consistently from 500 miles away. For anybody anywhere, who is content to hear both local and distant stations on head phones, this will supply a good radio set.

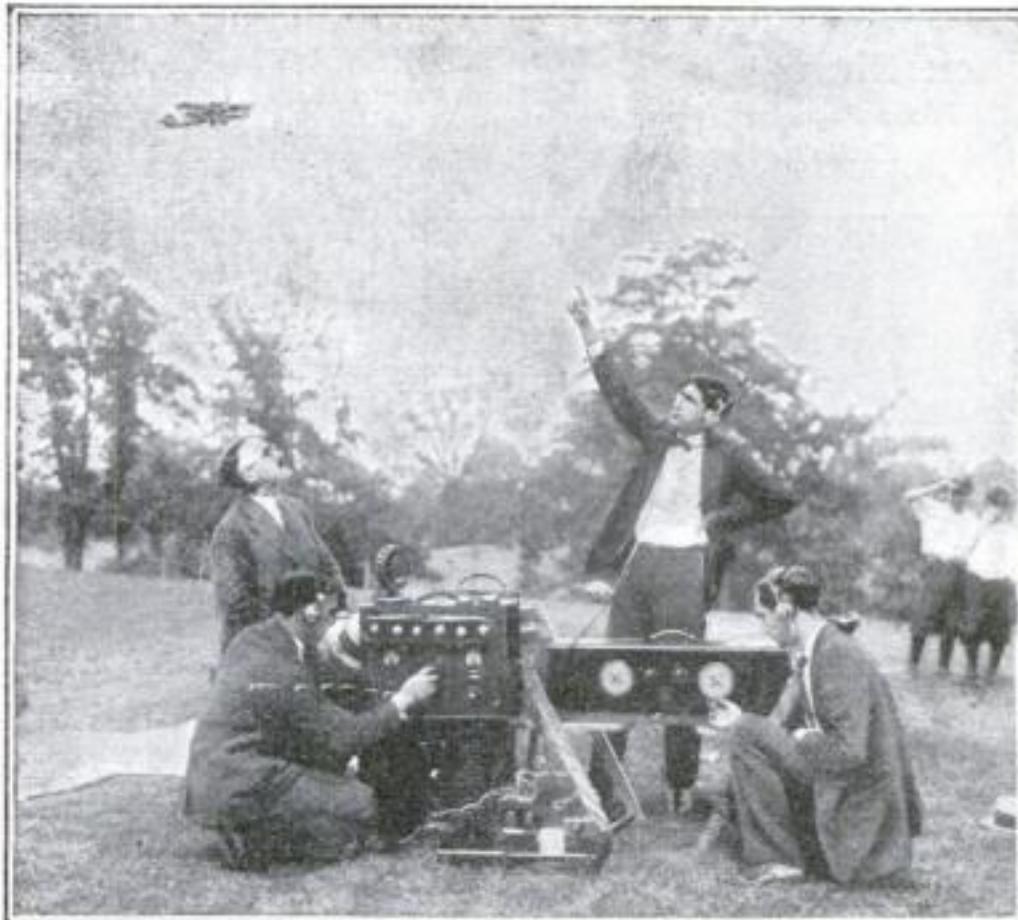
To most types of one-tube sets you can add one or more vacuum tubes and thereby improve the selectivity or sensitivity, or both. If you are within easy range of a broadcasting station and want louder signals so that you can listen in with a loudspeaker, a vacuum tube placed *after* your detector tube will accomplish the result by what is known as *audio-frequency amplification*; that is, the strengthening of signals already audible to you.

If, however, you wish to increase the range of your one-tube set, to hear stations that were too far away to be heard before, the addition of a tube *before* your detector tube will bring this about, the process being known as *radio-frequency amplification*.

Which kind of amplification is best, you alone know. Probably it would be better to buy a two-tube receiver complete at the outset. This you can do for from about \$18 to \$40. A good two-tube set usually will permit loudspeaker reception within 20 miles of a broadcasting station, and will give you a longer range in distance, using head phones, than a one-tube set.

New Tricks of Radio Broadcasting

Voices from the Sky, the Ocean Floor, and the Earth's Depths



Experimenters in Central Park, New York City, carrying on a two-way radio conversation with army aviators from Mitchel Field, flying overhead. Their talk was relayed by wire to a New York broadcasting station, where it was sent out to thousands of radio listeners within a radius of 200 miles. The photograph above shows the apparatus that picked up the airmen's messages



Two Princeton University students, David W. Richardson and E. G. Sisson, shown at the left during their recent experiments in transmitting and receiving radio messages from the car of a railroad train. Their tests may lead to radio equipment for trains everywhere



In the upper picture J. C. Jackson, deep-sea diver, is ready to descend to the ocean bottom, there to describe to radio audiences what he sees in the murky depths. The lower illustration shows how the sensitive microphone transmitter was arranged in the helmet, protected by a sponge



A FEW weeks ago an enterprising studio manager in Philadelphia hitched his broadcasting station to a diver beneath the ocean off Atlantic City. The diver carried on a running conversation describing the mysterious things he saw in the murk of the deep waters. Thousands listened to him.

"What possible benefit can there be from such radio stunts?" you may ask.

Consider the very first of the "stunts" in freak broadcasting. Two young amateurs took a small portable transmitter and receiver down a Derbyshire coal-mine in England to see what would happen. Their friends were above with

similar sets. Apparently the youths had little hope of success, yet successful radio communication was established.

As a result, today, we have a means of limiting the horror of future mine disasters by establishing communication with entombed miners, and so expediting the work of rescue.

Having succeeded in undersea and underground broadcasting, the next logical step was broadcasting from the air. A few days after the Atlantic City episode, Lieutenant Rasch of the U. S. Air Service flew over Central Park, New York City, and carried on a radio conversation with officers on the ground

beneath him. Their conversation was heard by thousands of radio listeners within a radius of 200 miles.

This performance, while it was merely a trick of radio broadcasting, may make it possible before long, for you to communicate with passengers in the air, using the regular telephone in your home or office.

SIMILARLY, such recent radio tricks as two-way communication on a speeding railroad train, the reception of messages in the tunnel under the Hudson River, and the successful broadcasting of the droning noises made by insects in flight—all have their useful significance.

And so the talk of the diver, doing his "stunt" at the bottom of the Atlantic, may lead to efficient new methods of deep-sea salvage, or to more widespread knowledge of the mysterious ocean floor.

Radio Warns of Storms

New Facts about Static—Useful Discoveries and Inventions

AN EXTENDED series of observations over a period of six years into the habits of static is yielding remarkable results in weather prediction by radio. The research in this particular case has been conducted at the British laboratories at Aldershot, where highly sensitive receiving apparatus has been employed with recording devices. Similar equipment now has been installed in an American station to supplement these observations.

The results thus far show there are practically three different types of static discharge; first, that known as "strays"—occasional discharges at irregular periods and irregular frequencies; second, the type of continuous static experienced in summer and in equatorial latitudes; and, third, the static existing at the head of a storm moving with great velocity.

By observing the last type of static, the British station succeeded in locating a storm 1000 miles away, and then with direction-finding apparatus followed the course of the storm over a distance of 1500 miles. The storm was one that swept over the Mediterranean Sea. Subsequent reports from the storm area completely corroborated the static-recording device.

The conclusion drawn from the observations is that static is produced by an onrushing column of cold air meeting the higher temperatures existing before the storm approach. With such apparatus it will be quite possible to predict the course and speed of any violent storm in time to warn inhabitants along its course. Also, the several investigations of static now under way almost certainly will result in the discovery of some method of preventing this nuisance of the air.

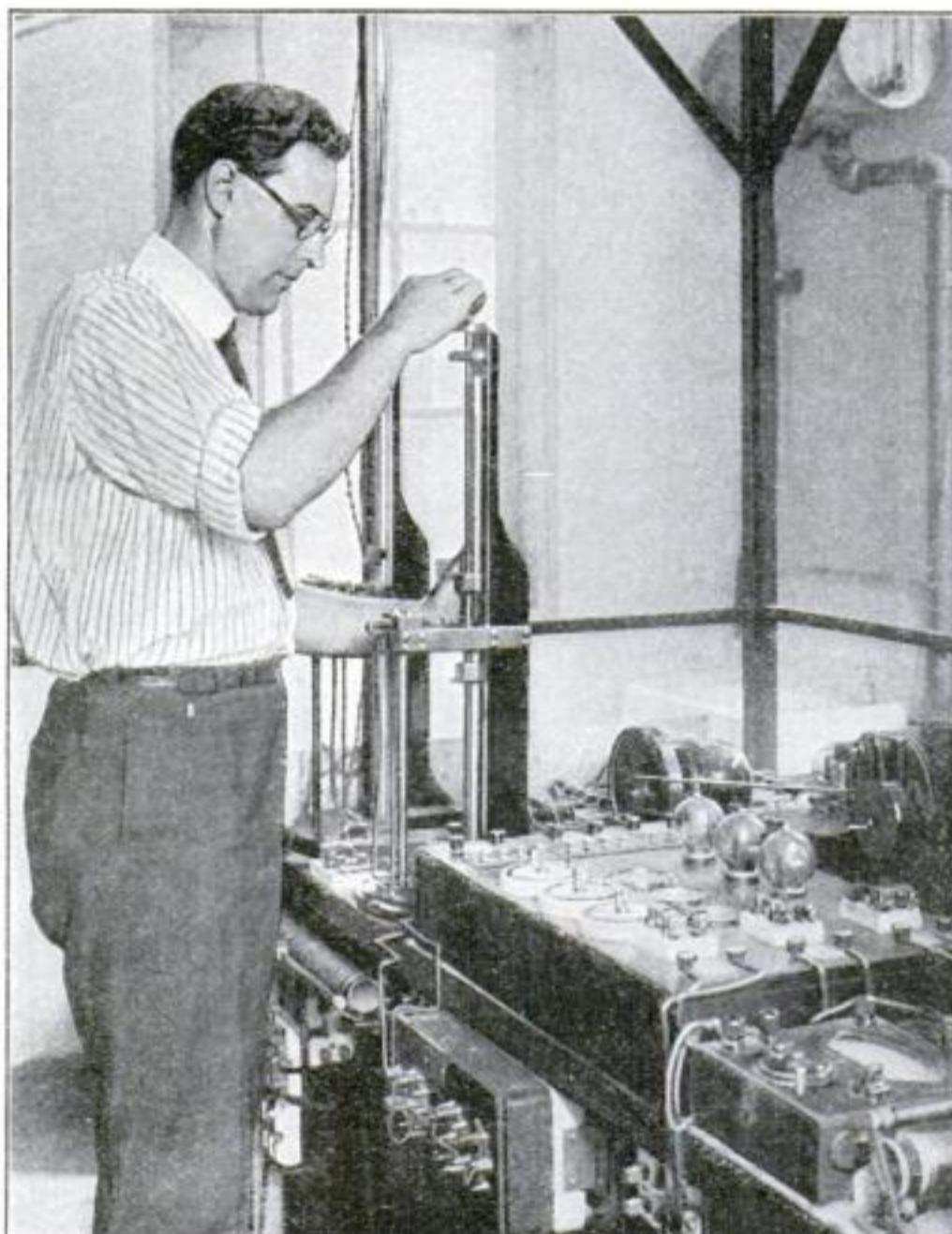
Tube without Batteries

AFRENCH inventor, M. Josz, has obtained a patent on the use of a filament constructed of radio-active materials in a vacuum tube. In place of a battery to light the filament, the substance itself is relied upon to emit sufficient electrons to operate the tube. Radium, polonium, mesothorium, or any other element endowed with radio-active properties may be used, the inventor says.

The use of radio-active materials for this purpose often has been suggested, but the cost always has been prohibitive.

By Jack Binns

America's Most Popular Writer on Radio



V. L. Chrisler, of the U. S. Bureau of Standards, testing building materials with his radio apparatus, which amplifies "noises" made by materials under stress

Whether the cost has been reduced in the Josz invention remains to be seen.

Another point to be determined is whether a sufficient electronic stream would be emitted by the substance to insure satisfactory operation for radio reception, especially in multi-tube sets. If the inventor has solved this problem, it is an important contribution to radio science.

A Radio Beacon

A NEW type of radio beacon has been evolved by C. S. Franklin, chief assistant to Senator Marconi. It involves the use of the reflected short-wave beams invented by the latter. Instead of the usual focusing "mirror" behind the transmitter, however, it is revolved in the same manner as a lighthouse reflector.

London Calling

RECENT experiments with transatlantic telephony by means of high-powered radio from the Rocky Point station at Riverhead, L. I., indicate that two-way communication across the ocean will be accomplished as soon as the new high-powered British station at Rugby is completed this fall.

The system employed is called "side-band transmission." It is accom-



This new type of radiophone, employing the beam system of communication between two points, may be useful in police work. It is the invention of Bernays Johnson, of Newark, N. J. (right)

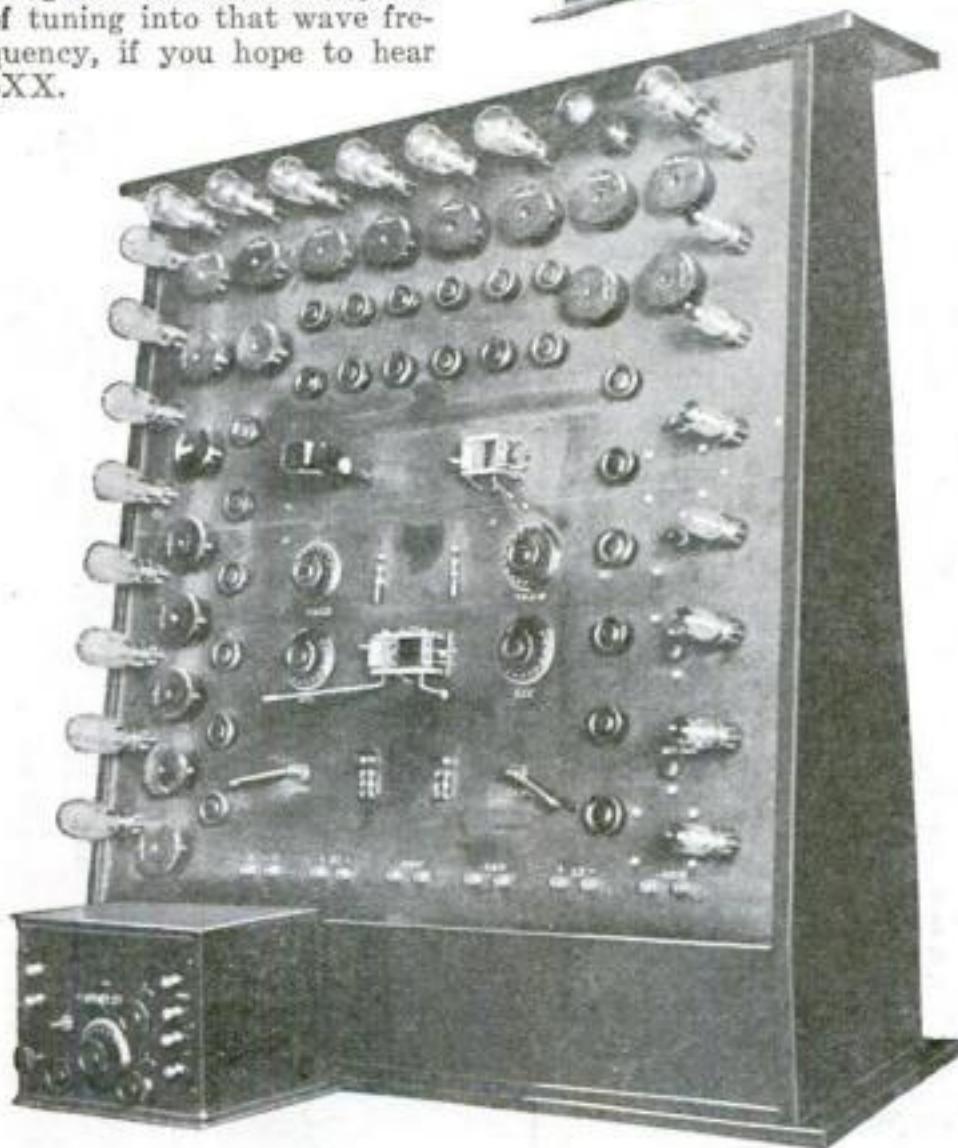
plished without the aid of a carrier wave. This wave, together with one of the side bands, is completely suppressed at the sending station, with the result that signals are transmitted across the Atlantic with only one-third the power that would be required normally. The missing carrier and side band are supplied by a local oscillator at the receiving station. The system also cuts down the possibility of interference, and permits more stations to operate in the normal wave-length bands.

Imagine talking to London as you now call up your office!

Listen for 5XX

IF YOU are of an experimental turn of mind, you will soon have an opportunity to listen in on one British broadcast station, with no fear of interference from local stations. This is the newly erected experimental station at Chelmsford, England, the call letters of which are 5XX.

The new station operates with a power of 25 kilowatts, or approximately 50 times the amount of power employed by the average first-class broadcast station in this country. The wave length used is 1600 meters. It will be necessary for you to employ a specially designed receiver, one capable of tuning into that wave frequency, if you hope to hear 5XX.



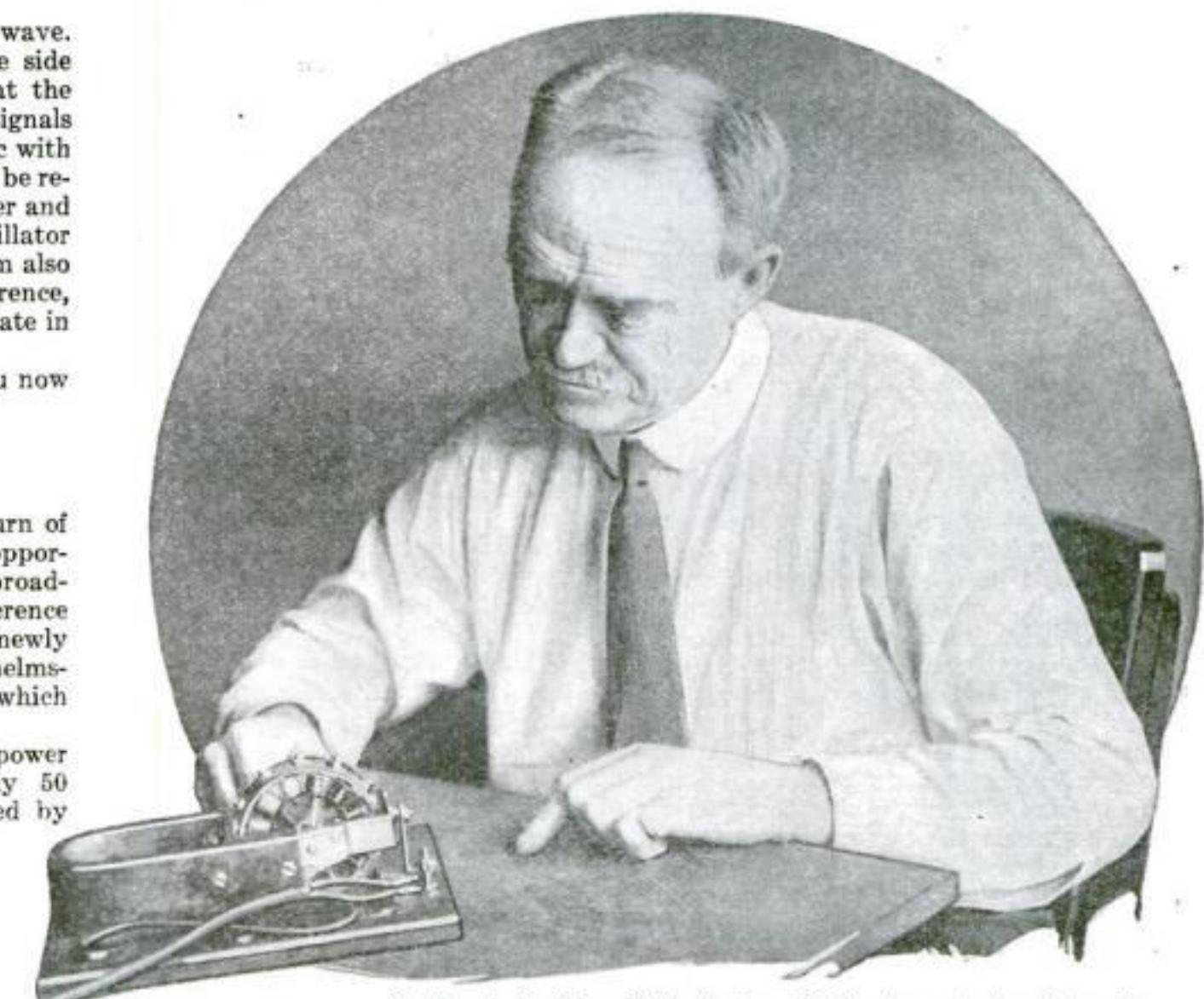
This 24-tube receiver, claimed to be the most powerful in the world, was designed in England especially to pick up signals from Mars during the planet's visit. Apparently, however, no Martian signals have been caught.

A New Vacuum Tube

THE Interdepartment Radio Advisory Committee of the United States has devised a new type of tube to be employed for reception purposes in the government service. The departure from the usual standard types is solely in the base and the method of making contact

establish communication where storms have disrupted light and power lines, as well as telegraph and telephone wires.

The truck, with its broadcasting equipment, is used to mobilize men and equipment necessary to make the repairs and restore service. The station has been heard as far West as Omaha, below the Mason and Dixon line, and as far north



C. Francis Jenkins, of Washington, D. C., demonstrating his newly invented radio motor, which revolves at high speed when attached to an ordinary receiving set in place of the usual loudspeaker. He believes his motor marks the first practical step toward radio power transmission.

with the socket. Four "knife blades" take the place of the usual prongs. The socket has four pairs of springs so arranged that the knife blades slip in between them. Much better contact is said to be obtained.

Motor-Truck Broadcasts

ONE of the most unusual broadcasting stations in America is station WTAT, which generally operates near Boston, Mass. It is installed on a motor truck, and can operate anywhere. It was constructed for the Edison Company of Boston as an experiment, and its chief purpose is to es-

as Labrador. Have you been able to enter WTAT in your radio log?

The Radio Stethoscope

BEFORE long your doctor may carry a small radio set as he now carries a stethoscope, for physicians are finding radio a valuable aid in diagnosis. The most recent contribution in this particular comes from Drs. H. V. Hellman and C. F. Fletcher of San Francisco, who are developing a radio apparatus that will measure the period of vibration of any affected organ in the human body. Comparison with the known vibrations of healthy organs, they believe, will permit them to determine what is wrong with the affected organ.

An Aid to Ships

A NEW system of antenna coupling has been developed by the U. S. navy radio experts, which permits several simultaneous receptions at different wave lengths while a local transmitter is being operated. This system is being installed on all war vessels. It has been added to the equipment of the *Leviathan*. Recently a test in New York Harbor enabled the ship to receive the broadcast program of WOO in Philadelphia, while WEAF (half a mile away) was operating.

With the new system the *Leviathan* can operate its long-distance transmitting and receiving equipment on a 2100-meter wave, while the regular watch for distress calls is being maintained on the international wave length of 600 meters. Further, it permits broadcasting at sea.

The restriction against ship broadcasting has been due to the rigid requirements of the strict watch for SOS calls.

A-B-C's of Your Radio Set

The Inside Story of Broadcast Reception in Simple Terms

This is the second of a series of articles by Mr. Martin explaining in non-technical, understandable language the principles and operation of radio. In the illustrations on this page each part of the set is accompanied by its radio symbol.—THE EDITOR.

By Robert E. Martin

IN MY last article I left you more or less "up in the air." That is to say, I traced the broadcasting process from the throat of the singer or the strings of the musical instrument to the aerial of the transmitting station. Now let us see what happens from the time the radio waves start their journey through the ether until you hear speech or music in your head set or loudspeaker.

You will recall that the electromagnetic waves that bear the radio program from the broadcasting station to your home are made up of a powerful "carrier wave," produced by the transmitting apparatus and modulated or interrupted in its vibrations to correspond with the sound vibrations produced by human voices, musical instruments, or whatever composes the broadcast numbers. You can visualize these waves, vibrating through the ether at the speed of light, if you think of the carrier wave as resembling the great crests and troughs of the ocean swells, and the modulations the little ripples that the big ocean waves carry on their backs.

Now, these waves obtain their electrical energy from an alternating current generator, which produces a current that reverses its direction rapidly at equal intervals. This kind of current will not operate a telephone or loudspeaker, and the production of audible sounds by means of one of these instruments, after all, is the sole purpose of your radio set. Whether it be a simple crystal set or a complicated multi-tube outfit, every piece of apparatus that composes it is designed for this one end. And so your radio receiver must be capable of transforming this alternating current into a kind of current that will operate a telephone or loudspeaker—a direct current, which means a current that flows in one direction continuously.

Also, the waves that speed from the broadcasting station vibrate at *radio-frequency*, or so fast that the ear would be incapable of detecting the movements

that they might cause in a telephone diaphragm. So your radio receiver must be capable of reducing this exceedingly rapid state of vibration to *audio-frequency*, or a rate of vibration that is within the audible range. If your radio receiver can bring these two things to pass, it has performed its function, and you will hear music or speech in your head set or loudspeaker.

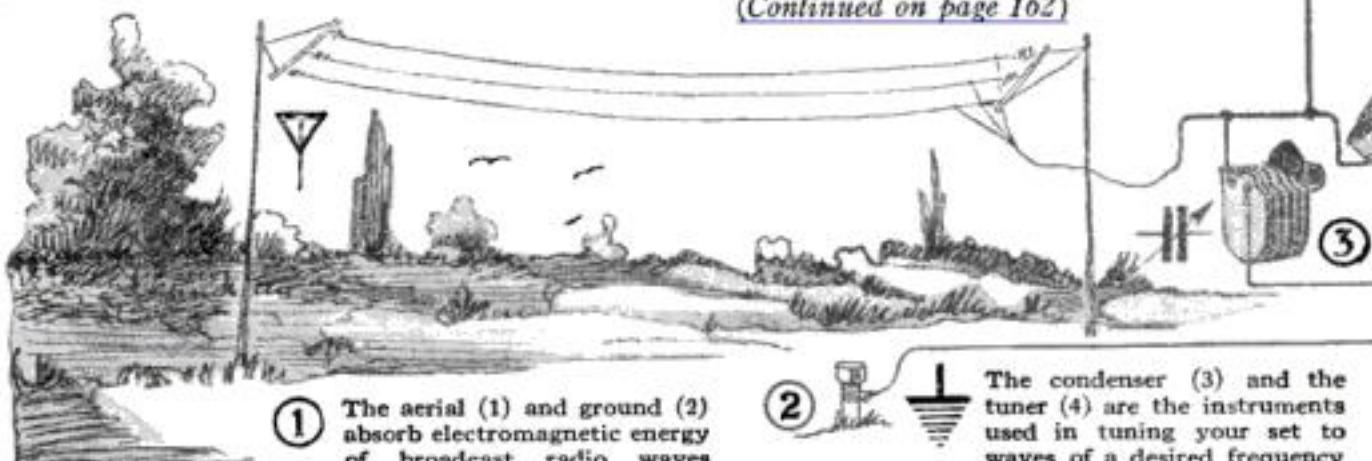
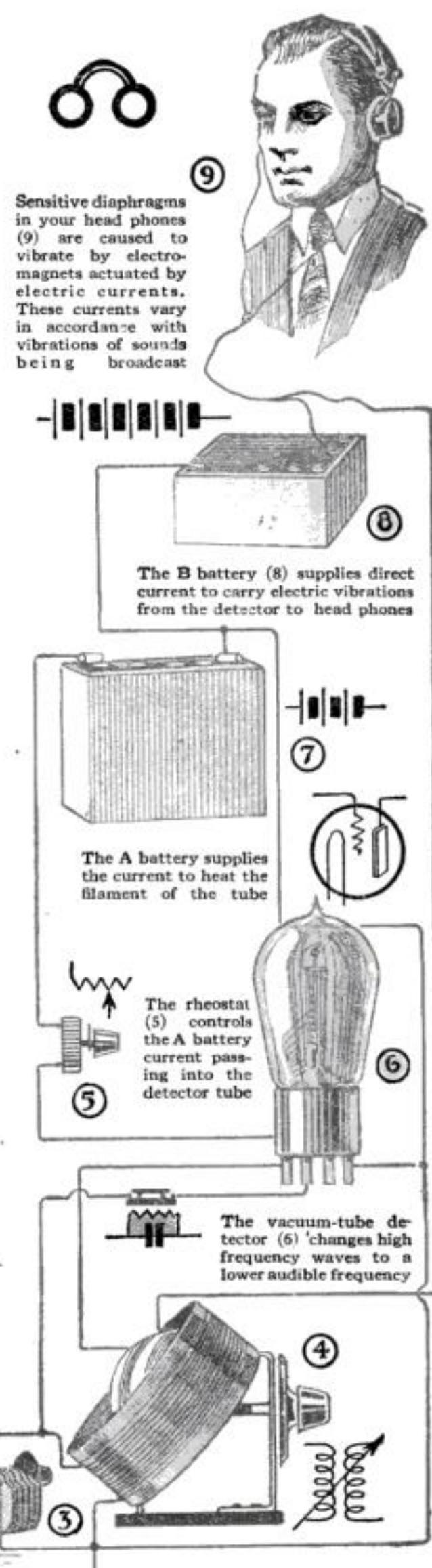
A radio receiver consists of four essential parts. 1. An apparatus capable of absorbing the electromagnetic energy of the radio waves. This consists of the aerial and ground wires, which, being conductors of electricity separated by the air, which is a non-conductor, form a "condenser." 2. A device capable of admitting to the receiver a carrier wave of a desired frequency of vibration and shutting out carrier waves of other frequencies. This is called the "tuner," and may be a single coil of wire or several instruments. 3. A device that will change alternating current of radio-frequency into direct current of audio-frequency. This is called the "detector" and may be either a crystal or a vacuum tube. 4. An instrument that will translate varying electrical currents into audible sounds. This, of course, is your head set or loudspeaker.

ALL radio waves that reach your antenna try to get into your receiver, and so in tuning a radio receiver, the problem often is not so much to tune in desired stations as to tune out undesired ones.

An analogy may serve to make the reason for this clear. No doubt you've noticed when a piano is played that a glass vase or some similar object will emit a sound each time a certain note is struck. The vase and one particular string of the piano, when struck, give the same musical tone; that is, each vibrates with the same frequency; and when the piano string sounds, its vibrations, traveling across the room, cause the vase to take up these vibrations and give forth a sound.

Now, if you were to tie a piece of string around the vase, or place some water in it, it would no longer vibrate when that particular note sounded from the piano, but would probably vibrate when some other note was struck. That would be because the material you added to the

(Continued on page 162)



① The aerial (1) and ground (2) absorb electromagnetic energy of broadcast radio waves

② The condenser (3) and the tuner (4) are the instruments used in tuning your set to waves of a desired frequency

Coils of wire in the tuner (4) admit to your receiver only waves of a certain frequency. The tuner supplies "inductance"; the condenser, "capacity"

How to Build a Short-Wave Receiving Set

And Hear the Newest Thing in Broadcasting

By M. B. Sleeper

AN OUTSTANDING development of the year in radio is the amazing success of extremely short waves—from 50 to 125 meters—in transmission that cannot be heard with the ordinary receiver. The results obtained over long distances with this new type of transmission are really astonishing. For example, programs broadcast from the short-wave station at Schenectady, N. Y., are heard regularly on the Pacific

Coast with two-tube short-wave sets, using loudspeakers. An amateur at Johannesburg, South Africa, reported that with a four-tube set he received "The Mikado" from the same station. Johannesburg is 8043 miles distant!

For the radio fan who wants to experiment with short-wave reception at small expense, Mr. Sleeper has designed the unusually efficient set which he describes in the following article.



Mr. M. B. Sleeper, one of America's foremost radio engineers, with the highly efficient short-wave receiving outfit which he tells you how to build in the accompanying article. It can be constructed both easily and cheaply

ONE of the most interesting phases of radio development, about which the public still knows very little, is the use of extremely short waves for sending and receiving by radio telephony and telegraphy. A short time ago radio engineers considered wave lengths below 600 meters of very little value for long-distance communication, but today the reception of Poldhu, the high-power station at Cornwall, England, on a wave length of 90 meters, is not at all unusual.

Regular experimental communication is being carried on at wave lengths sometimes below 50 meters. The dirigible *Shenandoah* is equipped with a transmitter to operate on about 90 meters. An experimental expedition being equipped by the Italian navy also will work on wave lengths under 100 meters. In addition, many amateur stations are operating on short waves, since the Government recently released the lower level for this work.

JUST what the developments will be it is not possible to predict, but unquestionably a very large part of radio research in the future will be along this new line, for the reason that below 80 meters very little trouble is experienced from static disturbances, while at 40 or 50 meters this trouble is almost entirely overcome. Another important factor in favor of low wave lengths is the large number of transmitters which can operate simultaneously without interference from

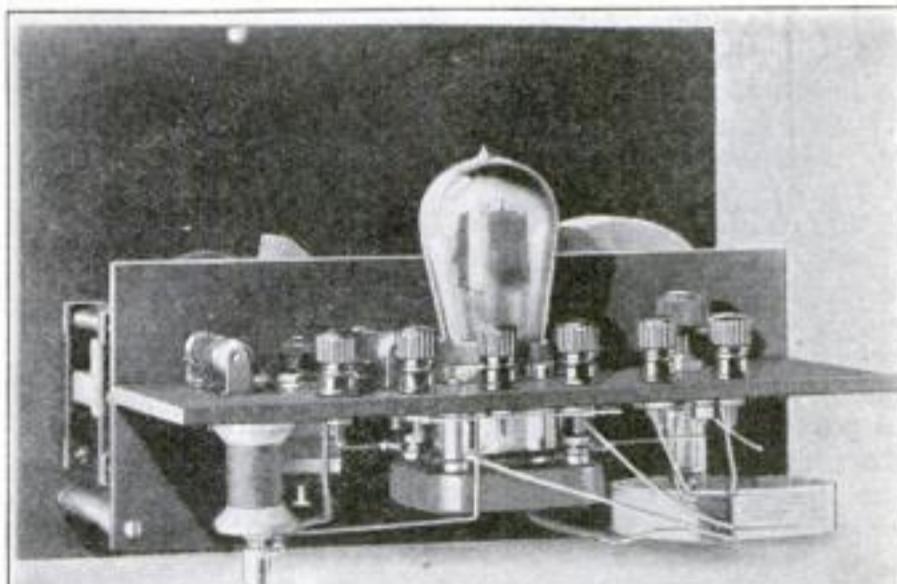


Fig. 1. Rear view of short-wave receiver, showing panel arrangement

each other, though they are tuned less than a meter apart.

In designing a short-wave receiver such as the one-tube outfit I shall describe here, there are special problems in connection with the elimination of energy losses that are not encountered in the construction of an ordinary receiving outfit. While the extraordinary precautions against losses necessary in short-wave transmitters are not required for the receiver, still a design somewhat different from receivers covering wave-length ranges from 200 to 600 meters must be used if real efficiency is to be obtained.

In the short-wave transmitter, though very small power is employed, the

extremely high-frequency currents break down almost any kind of insulation. The current passes right through ordinary materials, so that porcelain or special kinds of glass are needed.

FOR the short-wave receiving set, condensers and inductances designed for absolutely minimum losses are required to produce strong signals and to give sharp tuning. You will notice, in the rear and bottom views of the short-wave tuner (Figs. 1 and 3), that a self-supporting coil is employed. Not only is the tube, commonly used for supporting inductances, eliminated, but no shellac nor binder of any sort is put on the wire. This is because wherever insulation is employed

within the field of an inductance, a certain amount of energy is wasted by absorption in the insulating material. The higher the frequency, or the shorter the wave length, the greater is the loss.

The same thing is true for the variable condensers. The least amount of insulation must be used, and it must be so placed that it is not in the electrostatic field. The low-loss condensers

shown have small hard rubber strips. In a similar design, which will be perfected soon, special glass insulates the fixed plates from the movable ones. Such a condenser is equivalent to the quartz-insulated types used by the U. S. Bureau of Standards. In fact, the losses are so low that instruments now available cannot detect any wasted energy.

In this connection it is interesting to know that the developments in radio equipment this fall will be in the direction of greater efficiency through the elimination of losses, rather than in new types of circuits. So, even if you do not wish to construct a short-wave receiver of your own, I believe you will find, in the details

of its design, valuable suggestions for increasing the efficiency of the set you now are operating.

THE circuit I have chosen for this short-wave tuner is one that is not well known, although, in many respects, it is by far the most satisfactory regenerative hook-up, not only for short waves, but for the broadcast band as well. The tuning inductance has three coils—one connected with the antenna and ground; a main inductance, serving as a secondary, which is wired to the grid and filament of the tube, and a third coil that serves as a fixed tickler to give the regenerative action.

Regeneration is controlled not by moving the tickler, but by varying the capacity of a condenser which, as you will see from the wiring diagram (Fig. 7), is in

ment the regeneration control is perfectly smooth from zero right into oscillation. Thus the maximum point of regeneration can be reached, a thing which is impossible in the movable coil sets.

During the winter season it is predicted that the condenser-tickler circuit will become extremely popular for all kinds of receiving sets, particularly since it can be used for reflex sets as well.

As to the mechanical arrangement of the

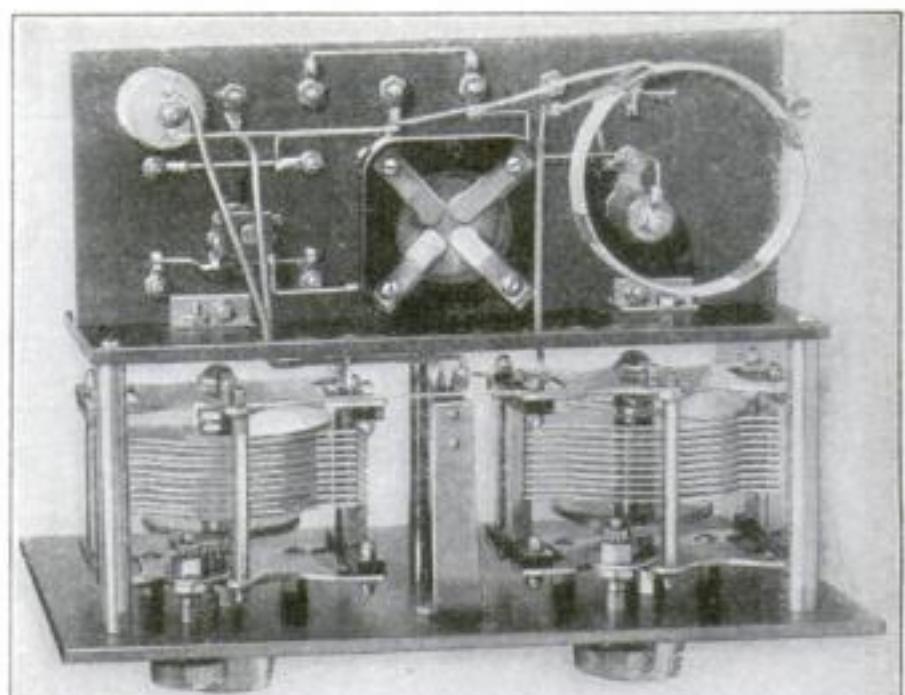


Fig. 3. Bottom view, showing inductance coil and connections

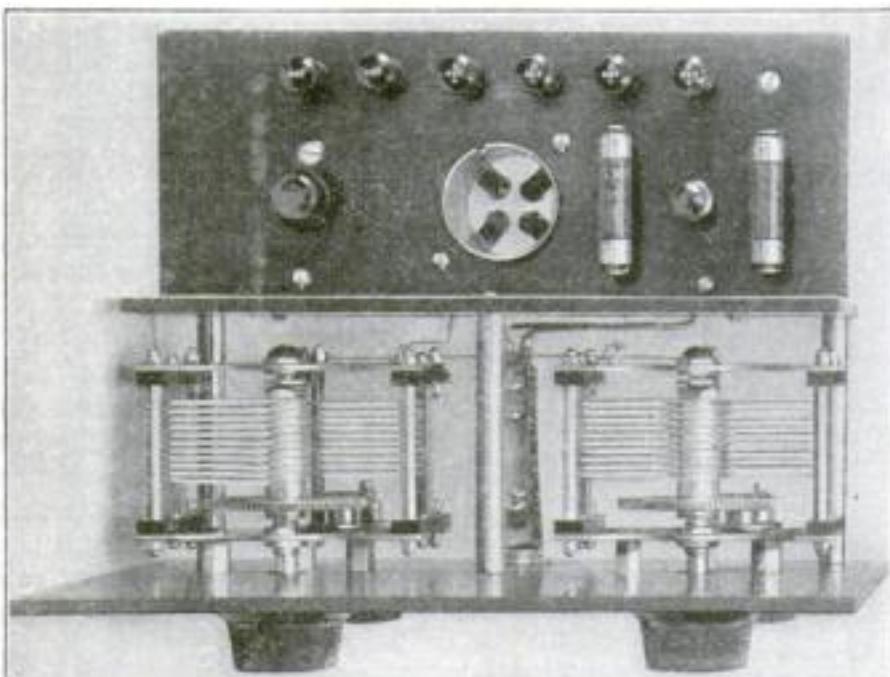


Fig. 2. Top view, showing the layout of the tube panel

series with the tickler of the set.

There are several advantages in this system. In the first place, an adjustment of the regeneration does not affect the wave length, as is true of adjustable tickler receivers. Moreover, it makes the mechanical arrangement very much simpler, since the windings form a single unit, and the control of regeneration is far more steady than when a movable coil is employed.

You probably have noticed that regenerative sets give a gradual increase of signal strength up to a point where they suddenly break into oscillation, and the signals become distorted. With the condenser-tickler arrange-

outfit, you will see in Figs. 4, 5 and 6 dimension drawings for the panels on an exact scale of $\frac{1}{4}$ inch to an inch actual size. The exact drilling for the front panel (Fig. 4) will vary according to the type of condenser used. It is important to have a Vernier adjustment on each condenser to accomplish the extremely fine adjustment necessary. The three holes for screws which hold the panel-support pillars must be exactly located so that

they will fit with those in the sub-panel (Fig. 5). On the sub-panel are four holes to take wires connected with the condensers and telephone jack, and two for screws which hold on the small brass angle brackets.

The tube panel (Fig. 6) is drilled for the binding posts, the combination adjustable grid leak and grid condenser, contact clips, the socket, choke coil, and angle brackets, as well as the filament circuit-control switch.

THE hole for the socket may puzzle some experimenters, although it is a simple matter if you use a panel cutter. This can be obtained in the exact size, $1\frac{1}{2}$ inch in diameter. A small hole is made first to take the center plug of the panel cutter.

Since the set is assembled from standard parts, there is very little actual construction work except for the inductance unit and choke coil. The choke coil is simply a small thread spool wound with about 200 turns of fine wire—anything from No. 36 to 40 will do. This wire can be taken from an old spark coil secondary or from a 75-ohm telephone receiver.

The inductance coil (Fig. 8) is a little more difficult to wind, although it is easy enough if you follow the instructions carefully. Get a glass bottle from $2\frac{3}{4}$ to 3 inches in diameter. Cut five strips of gummed paper tape, such as is used to fasten packages. The strips should be about $1\frac{1}{2}$ inch long and $\frac{3}{8}$ inch wide. Get a quarter-pound spool of No. 20 d. c. e. wire for the coil.

Fasten the end of the wire around the neck of the bottle and put a short rod through the spool, holding the rod at each side with your feet. This is to provide a simple brake on the spool so that it will unwind only as you turn the bottle. Put three or four turns around the bottle and get the (Continued on page 166)

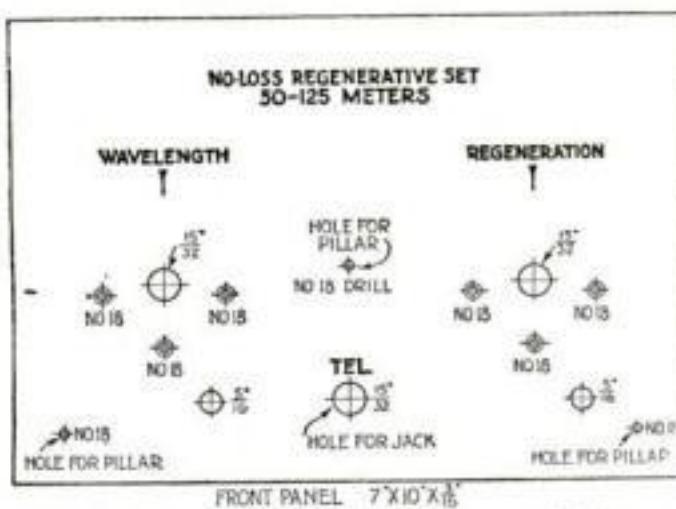
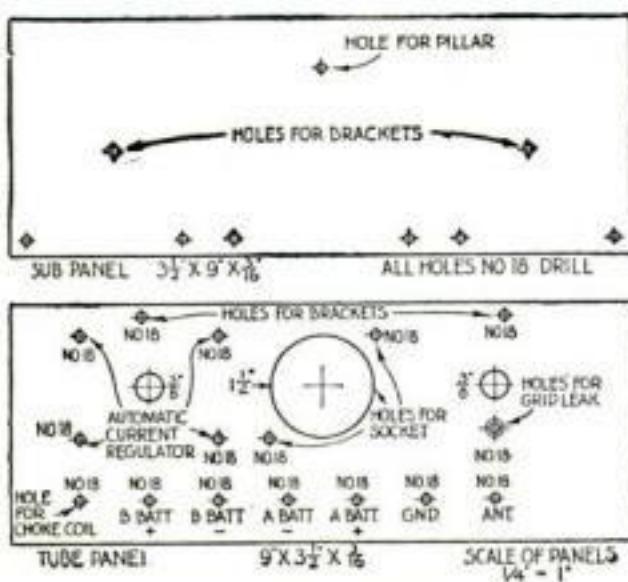


Fig. 4. Dimension drawing of front panel with exact measurements for drilling, on scale of $\frac{1}{4}$ to 1 inch



Figs. 5 and 6. Drawings for sub-panel and tube panel, with exact measurements for drilling

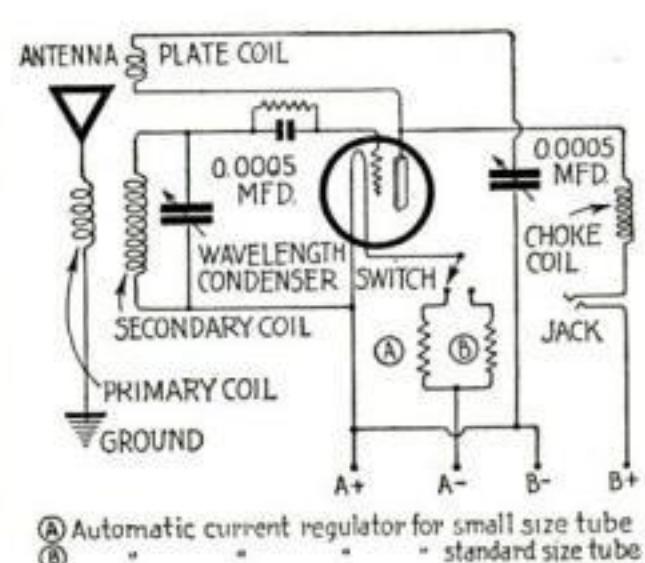
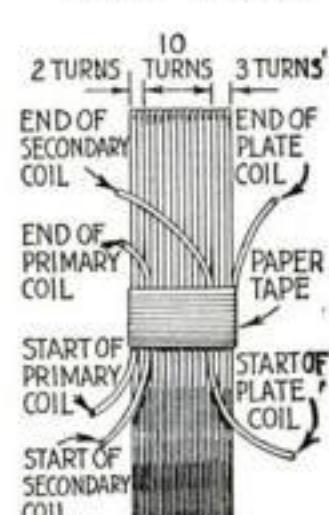


Fig. 7. Circuit diagram for the short-wave receiver. This wiring should be followed exactly



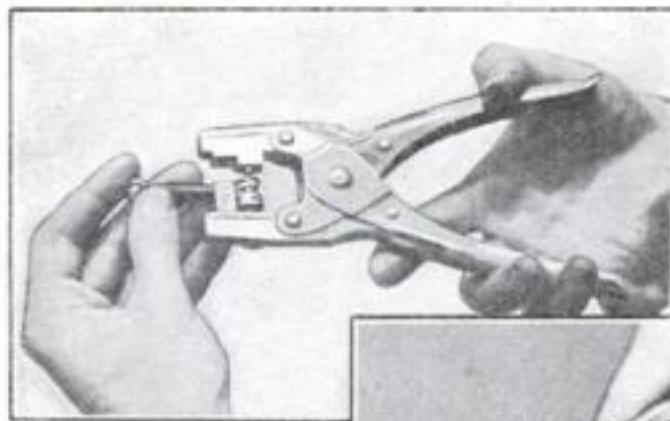
Showing the winding of the inductance coil

Handy New Tools for Wiring

Practical Radio Hints that Everybody Can Use

IF YOU are constructing your own radio set, or experimenting with new hook-ups, one of the chief requisites for a good job is an efficient set of tools for handling, cutting, bending, and fastening the wires.

Three new tools designed to simplify the task of wiring recently have been



brought out to meet two bare-tipped wires.

By touching these tips to the suspected circuits, you can determine at once whether the circuit is complete or not. If it is complete, the lamp will burn, brightly or dimly, depending upon the resistance of the circuit. If the circuit

At the left is an ingenious punch for making loop terminals quickly and neatly. The pliers below are designed especially for looping the terminal ends of wires for attachment to the binding posts

invented. One is a stripper that removes the insulation from the ends of wires quickly and neatly. The end to be stripped is simply inserted in a receptacle in the tool and the handles are compressed. Sliding jaws remove the insulation at a single stroke. A wire-cutter is included on the same tool.

For quickly and conveniently making loop terminals on long or short connections, another pair of pliers clamps the terminals on the wire firmly with a single punch. Where it is merely desired to loop the end of the wire for insertion on a binding post, another pair of pliers quickly provides a neat and convenient loop. One of the jaws is rounded so that the end of the wire is forced into a circular position.

Testing Radio Circuits

A VERY useful accessory for the radio workbench is a small flashlight battery and lamp, the wiring of which has been cut and the two ends of it

is open, the lamp will not burn. The device can be used also in testing for short circuits.

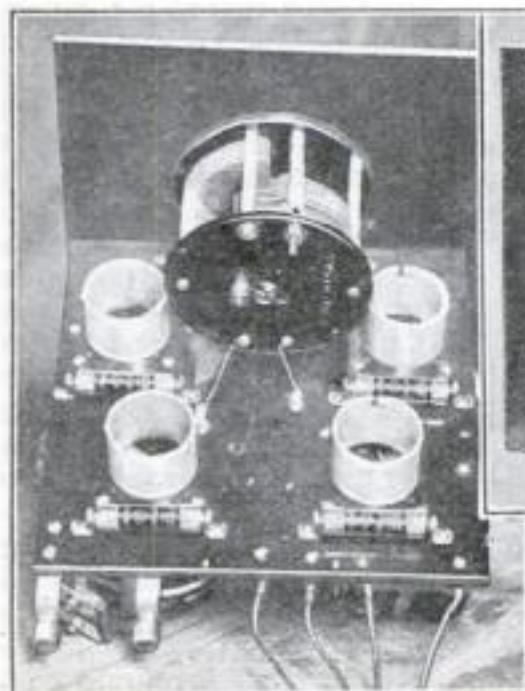
How to Make a Fixed Crystal Detector

A FIXED crystal detector that will stay in adjustment can be made by any experimenter out of a short piece of glass tube, two bits of bus wire, two corks, and some crystal galena.

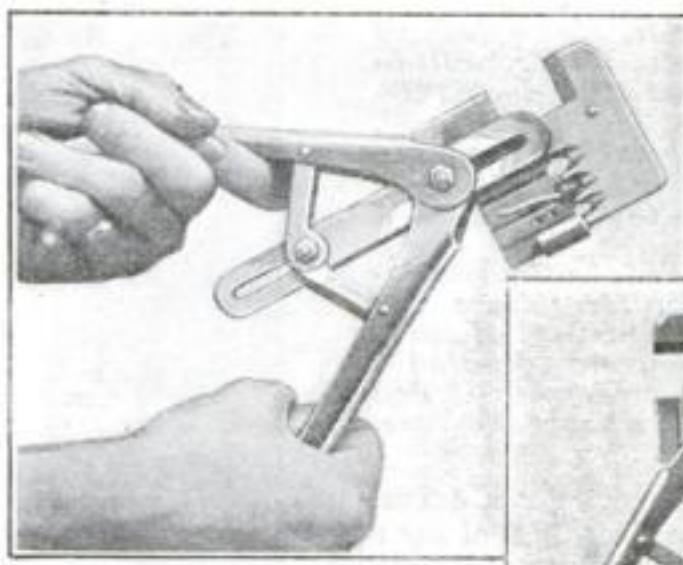
The glass tube should be about a quarter of an inch in diameter inside, and about 1½ inches long. Such a piece of tube can be obtained at most drug-stores. Get two corks that fit snugly into the ends of this tube. Heat the pieces of bus wire (or other hard copper wire) and thrust them through the corks, so that the ends of the wires project inside the glass tube but do not touch each other.

Now take a piece of galena, such as is used in the ordinary crystal detector. Mash it to coarse powder, being careful to use a clean hammer and not to touch the crystal fragments. Pour this powder into the tube, and cork up the tube.

The two wires will project into the crystal powder and serve as



A recent radio novelty is a four-tube tuned radio-frequency set with a single dial control. Two condensers are on one shaft. The tubes are controlled by a new self-adjusting rheostat



Above are two views of a new tool for stripping insulation from the terminal ends of wire—a task usually done with a penknife. Sliding jaws strip off the insulation when the handles are compressed, making a neat job of it



contacts for the detector. If at any time this detector ceases to work, a gentle tap with the finger on the glass tube will restore it to sensitivity. Very often, in crystal sets or reflex sets, the use of a fixed crystal detector is a cause of trouble, simply because it is fixed on the wrong spot. Obviously this common difficulty is obviated in the detector described.

Neutralizing Battery Acid

IF ACID from a storage battery spills on carpets, floors, or clothing, the best way to neutralize it is with a thin paste of baking soda and water. Spread this generously over the acid until the bubbling stops. Then wash off the soda with water. The neutralizer must be applied as quickly as possible.



Time signals sent by radio from the Arlington station each noon, automatically set this self-winding clock, which in turn is capable of operating and controlling any number of clocks. This invention may make possible the setting of the nation's clocks by radio

Why It Pays to Nail Your Furniture to the Walls

Built-In Features Save Money and Add Beauty to Your Home

By L. Porter Moore

Last month Mr. Moore pointed out the advantages of built-in equipment and labor-saving devices in the kitchen, pantry, laundry, and breakfast nook. In this article he suggests attractive built-in furniture for the living quarters.

As president of the Home Owners' Institute, Mr. Moore has helped plan thousands of small homes. If you are planning a home of your own, you will find helpful ideas in what he says here.

"IF EVER the moving-van draws up to this home door, half of my new furniture will never go on it because it's now part of the house-nailed right into the walls to stay."

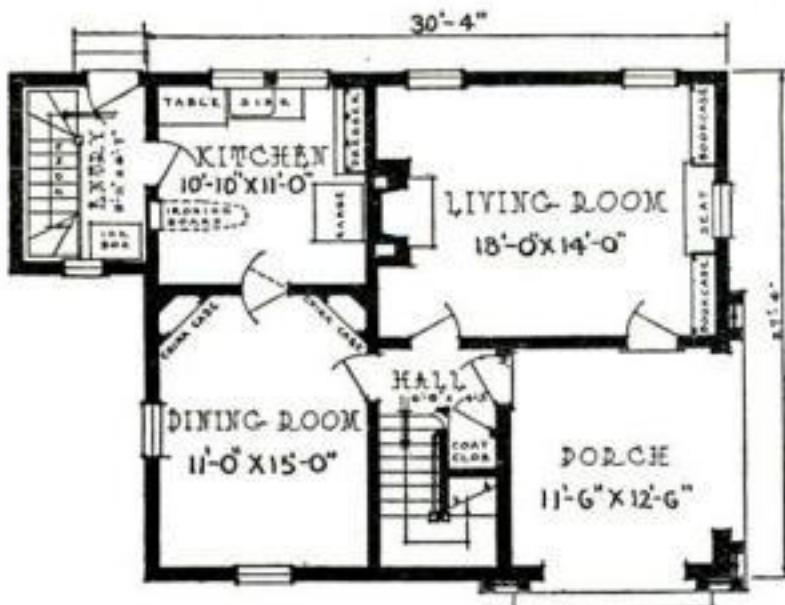
Almost gleefully, a friend of mine who had just completed a home of his own made this somewhat surprising comment to me the other day.

"Your furniture nailed in!" I exclaimed. Then it dawned on me; I had seen his architectural blueprints and specifications



In this seven-room house, designed by Frederick L. Ackerman, distinguished American architect, the floor plans (below) illustrate how

furniture and equipment can be built into a small home advantageously. Notice how simple, built-in features increase the wall space



First-floor plan, showing built-in conveniences

indicating the locations for many of the new built-in, permanent furniture features.

"Yes, our new house has in it about every conceivable piece of useful built-in furniture catalogued," my proud friend added. "And my wife is as pleased as a peacock. It's useful, practical and decorative, and saved me money. Why, we had to buy hardly a stick of new movable furniture, for every room was almost furnished when we moved in."

It is safe to say that well selected "permanent furniture"—which comes under the sub-contract heading of "mill-work" in house construction—often will convert a mere house into a home, even before the movable furniture is moved in, as my friend and his wife found out. Among the most important of these built-in pieces are bookcases, window-

seats, china closets, sideboards and buffets, benches, bedroom dressing-tables, tray cases and medicine cabinets.

Built-in furniture is proving just as practical and popular in the farm home as in the city home today. Lumber dealers everywhere carry in stock permanent pieces that may be installed in a home by the carpenter on the building job, or by the home-owner who is handy with saw, hammer, and paint brush.

Built-in furniture is especially serviceable in a small room, because it takes and

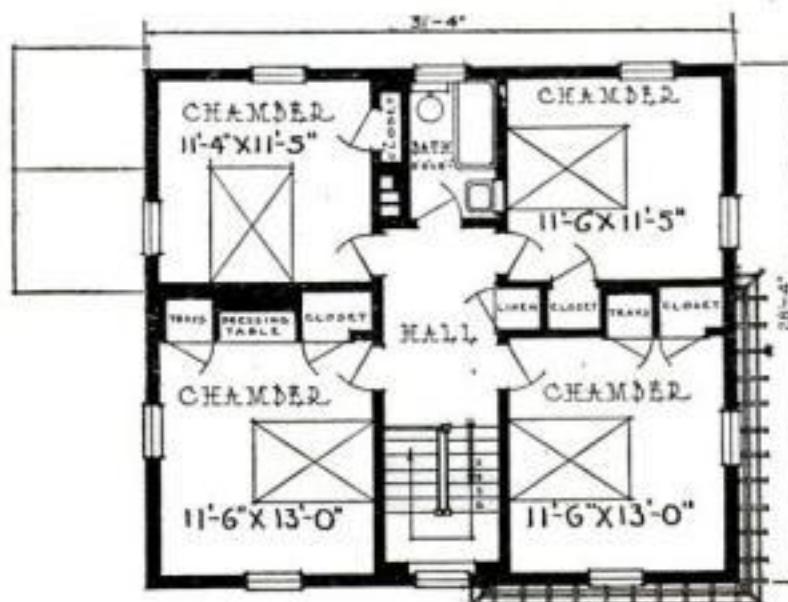
keeps its place as a part of the wall, and increases the floor space. It is advantageous also in a room of great size, because it then may be of fine decorative value.

FREDERICK L. ACKERMAN, internationally known member of the American Institute of Architects, who served as Chief of Design of the Bureau of Housing of the Emergency Fleet Corporation during the war, has designed a most practical plan for a small seven-room house in Western architectural exterior. Its floor plans, reproduced on this page, show how advantageously and practically built-in furniture and equipment can be utilized in small home construction.

I paid a visit to Mr. Ackerman's New York office not long ago. I asked him what the architect of standing thought of so-called stock millwork and furniture. He said to me:

"Some people may question whether good architecture may be made of standardized details and forms. From my point of view it does not matter whether they be standardized details and forms, so long as they are good forms."

"Smaller houses in England," he continued, "which are rated as being among the best examples in domestic architecture, were built from



Second-floor plan. Note the handy closets and trays

what might be considered standardized details. In the same way, in American Colonial architecture, we find upon examination that there were comparatively few forms, and these were of a standardized character, in the main.

"It is upon the designs of woodwork items or architectural 'details,' such as the doors, windows, molding trim and permanent furniture that the architectural character of every house depends," Mr. Ackerman told me. "To make it possible to effect economy in the construction of a home today, manufacturers of millwork are producing these standardized items in attractive designs that are correct architecturally."

I KNOW a family that built a home and equipped it throughout with stock trim and permanent furniture. The bookcases, window-seat, mantel, Colonial china cases, kitchen dresser, ironing-board, bedroom dressing-table, tray closets, bathroom cabinets, and the like, purchased from stock through the local lumber dealer, cost somewhere around \$800.

"How much do you think you saved by building in that furniture?" I asked the owner.

"I've just tried to figure it out with my wife," he replied. "After buying certain smaller pieces of movable furniture we needed, and pricing large pieces that we should have had to purchase if our plan had not called for the built-in furniture, she estimates that we have saved something like \$500. Movable furniture, we finally concluded, would have been from 59 per cent to 100 per cent more expensive."

The selection of millwork is fully as important, in the original planning of the home, as the actual selection of the structural materials—brick, stucco, hol-

low tile, frame, local stone, or what not—and should come in for as much consideration as floor plans or arrangement of rooms upon which the person about to build usually places a great deal more emphasis, I have found.

But this house probably is an exception. Usually it is the case that after the home is built and furniture moved in, the search begins, with funds frequently at low ebb, for detached furniture that might have been installed far better while the house was "in the shell," and when the carpenter's work would have contributed to the architectural beauty of the whole. Calling in a carpenter to install furniture after the house is finished is equally wasteful.

In planning a house, every room lends itself to some sort of built-in furniture. For your living-room you should make provision for bookcases flanking the fireplace or in some other convenient place. Movable cases never have the homelike appearance of built-in shelves. Also you may want a magazine rack recessed into the wall, and a window-seat or some other kind of bench. And a built-in writing desk is both beautiful and useful. All these are easily installed.

IN THE dining-room by all means plan for a built-in sideboard. This, you will find, becomes as naturally a part of the room as the wall. China closets with triangular backs that fit into corners or square backs to fit into recesses, also are useful and exceedingly attractive. If you have a dining alcove, you will want a table folding up into the wall, and benches built against the wall or folding into it.

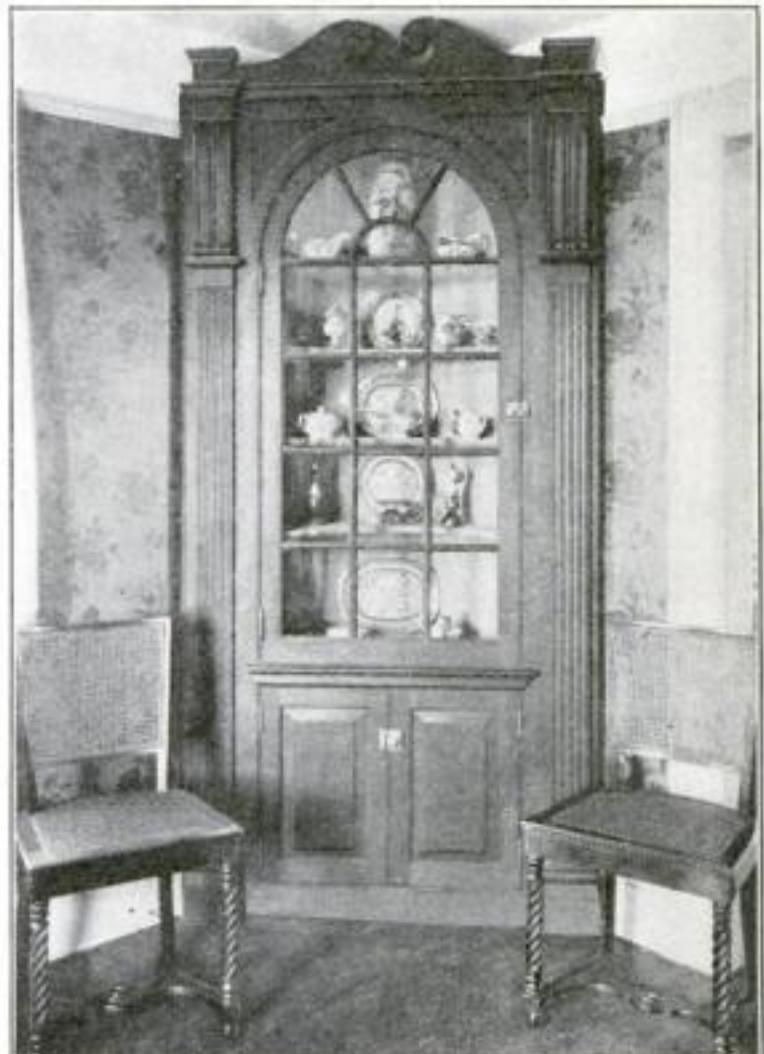
For the bedroom you certainly should plan for a dressing table built in where the best light falls, a linen-case running to the ceiling, with plenty of drawers, and a window-seat. In small bedrooms a bed closet with a let-down bed might well be installed.

In the bathroom a spacious medicine cabinet should be built in above the hand bowl, and a corner closet should be included for the towels. Also a dressing-table may be included if the room is large enough.

All these features are taken care of easily in building a house; but if the house has been built without them, you still may have them put in or put them in yourself.

In most old houses there are numerous alcoves that seem to have been provided for no apparent reason. These afford excellent places to build in useful furniture. Usually one of these alcoves is in the hallway. It can be

transformed easily into a closet or tray case for umbrellas, rubbers, wraps and other similar articles. Where you find an alcove in the bedroom, a linen case is the logical thing to fit into such a space.



This Colonial china closet of stock design and material, set in the corner of the dining-room, is both useful and beautiful, yet comparatively inexpensive to build in

In the living-room there often is a recess on each side of the fireplace. These are ideal for building in bookcases. They will save space, consequently making your room larger, and will add to the attractiveness of the fireplace itself. Bookcases can be built also in the bays formed by pilasters. Window-seats with lids or with drawers in them are easily constructed in little-used corners.

In some old houses special recesses were provided for movable sideboards. If this is the case in your house, it will be a simple matter to build in a sideboard to fit the recess. If there is no recess, there surely will be a blank wall space that actually calls for a built-in piece. You will find that a little carpenter work will transform your dining-room and give you lasting satisfaction.

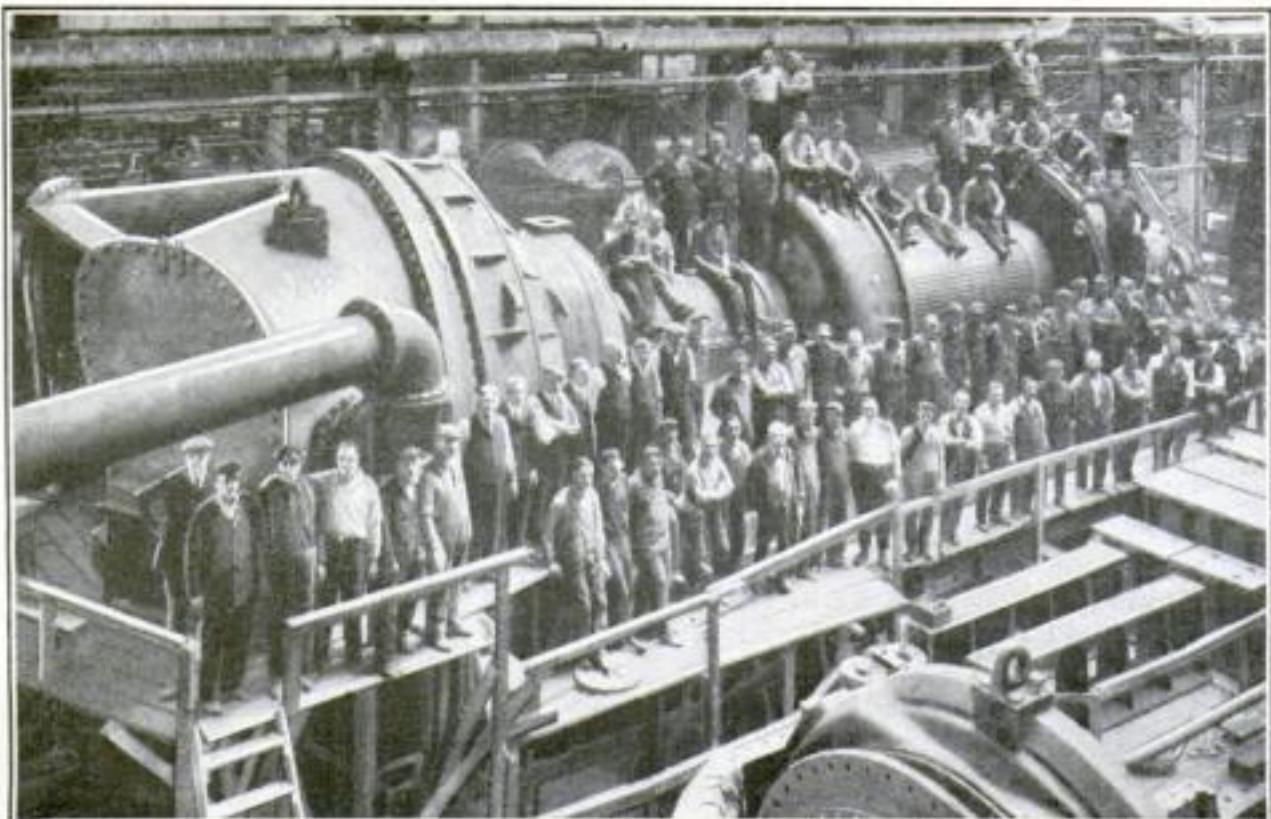
CHINA closets can be built into any corner without much trouble and if you are skilful with tools, you can make the job look as if it had been done when the house was built. Of all built-in pieces the china closet probably is the easiest to construct and fit.

Of course, your sideboard should have a large drawer for table linen; but if you want additional drawer space, a low chest can be constructed in front of your windows, or between them, if they are well spaced. The space under a high, small window is an ideal place for a built-in chest of drawers.

For storage, convenient tray cases can be built under the eaves in the attic. This space seldom is used, but it can be made highly useful.



Built-in bookcases such as shown above are practical equipment for the small-home living-room that also must serve as the library, where the family likes to gather



Huge Generator Does Work of 5,400,000 Men

A MONSTER steam generator which, it has been estimated, is capable of doing more work in 24 hours than could have been performed by the entire slave population of the United States in 1860, has been constructed by the General Electric Company for installation in an Illinois power station.

It is rated at 80,000 horsepower, or 60,000 kilowatts, and includes both high-pressure and low-pressure units.

The steam that has been used in the high-pressure section is re-superheated before being used in the low-pressure unit. Exhaust from the low-pressure turbine flows into two passages, each leading to a large vertical condenser.

A graphic illustration of the power of a generator of this size was given briefly by the late electrical wizard, Dr. Charles P. Steinmetz, as follows:

Each horsepower is equal to the muscle work of $22\frac{1}{2}$ men, so that 80,000 horsepower would equal the work of 1,800,000 men. But a man cannot work 24 hours a day, while the turbine can and does work that long. Therefore the big Chicago turbine will do the muscle work of three times 1,800,000 men, or supply as much energy as 5,400,000 men working in three eight-hour shifts, thus exceeding the capacity of the entire slave population of the United States before the Civil War, which was 4,700,000.

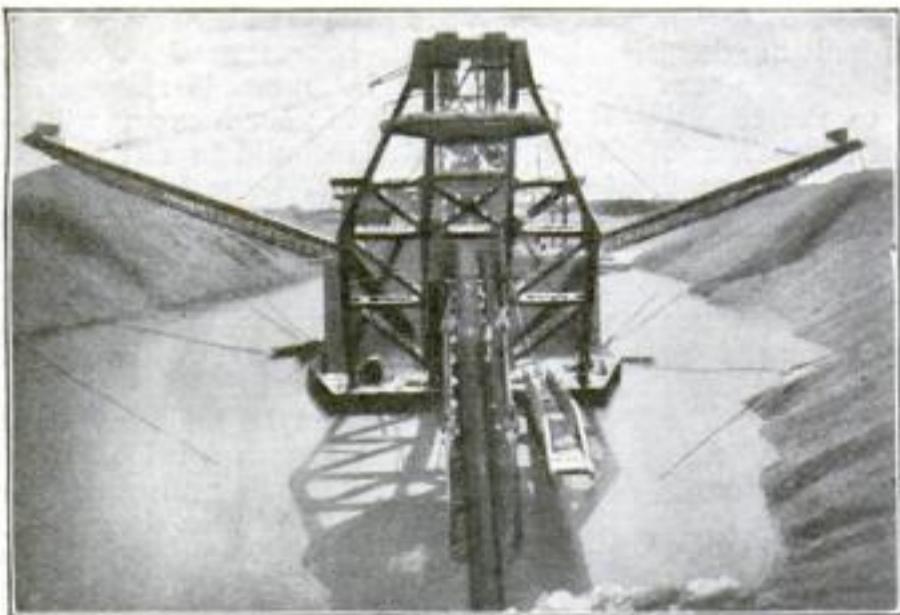
Acres of Gold Dug by Mammoth Dredges

THE largest gold dredges in the world are to be found at Hammonton, Calif. More material has been turned

dredged and another 1000 remain unworked.

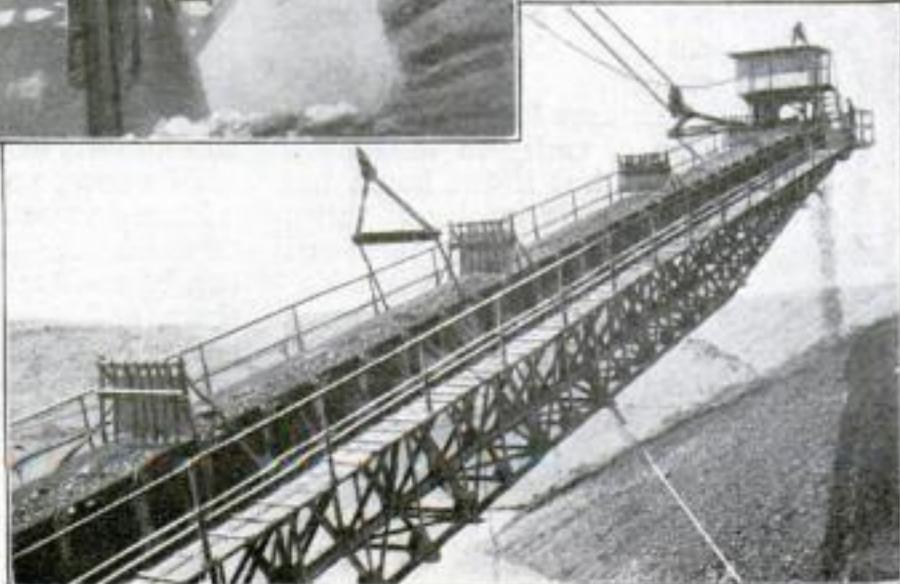
The dredges plow through the virgin soil down to solid rock. They are capable of digging 82 feet below the water line. Each dredge is 165 feet long, 68 feet wide, and the side arms have a spread from tip to tip of 420 feet.

Rock-crushing plants are installed in the wake of the dredges.



Above: Dredging for gold under the water. At the right: One of the great side arms of the gold dredge

over in gold excavations in this district in the last 20 years than was turned over during the construction of the Panama Canal. More than 2000 acres have been



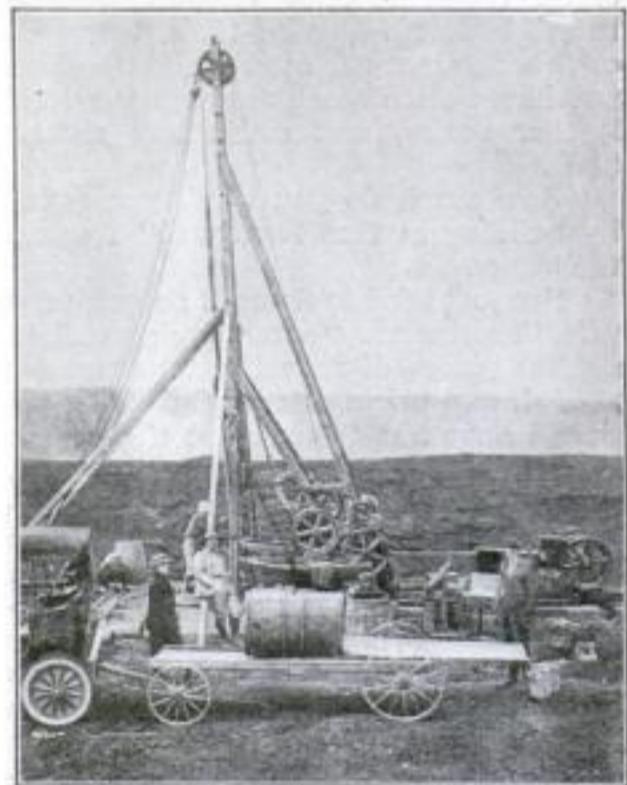
Exploring the Mysteries of Kilauea's Crater

TO MEASURE the temperatures in lava at various depths, a party of United States volcanologists are drilling a series of holes in the huge crater of Mount Kilauea in Hawaii.

The possibility of utilizing the steam from the crater for power purposes will be studied at the same time. To do this a small laboratory with small engines and condensers has been built over the hottest of the crater holes.

In drilling, much difficulty has been encountered, due to the great hardness of the basalt rock that forms the solid lava foundation. It is possible to bore only two or three feet a day.

The work is expected to reveal new facts concerning the increase in tempera-



Drilling outfit in Kilauea's crater

ture toward the center of the earth, as well as new knowledge of mineral and gas changes underground.

Advocates Improvements in Locomotive Whistles

CROSSINGS are made unnecessarily dangerous and millions of dollars worth of steam is wasted annually by whistles now used on leading railroads in America, Prof. Arthur L. Foley of Indiana University has reported to the Indiana Academy of Science. The whistle should be placed in front of the smokestack, he declares, and should have a reflector behind it. In addition, it should be raised in pitch.

Every time the ordinary locomotive whistle is blown it uses the steam produced by two pounds of coal. Professor Foley estimates that the ordinary locomotive wastes 36 pounds of coal and 140 pounds of water an hour in whistling. Since there are 65,000 locomotives on Class A railroads alone, the cost of blowing whistles runs into millions.

Most of these whistles, Professor Foley claims, are from one to two octaves too low in pitch to be heard to the best advantage. Raising the pitch, he concludes, would mean smaller whistles and less steam consumption.

Telegraph Poles Set Up by Machinery

A MACHINE that not only bores the holes for telegraph poles, but also sets the poles in position, has been perfected recently to save time and labor. With three men operating it, it is claimed to do the work of 60 men.

The apparatus consists of a giant earth boring machine and derrick mounted on a motor-truck. Driving force is applied to all four wheels of the truck, making it possible to travel the roughest roads.

Power for the boring machine is supplied by the truck motor. The machine—a giant auger—is mounted on a turn-table so that it may be swung to any position. It will bore holes up to four



Drilling a hole with 48-inch auger

feet in width and 10 feet deep in any kind of soil, in from $1\frac{1}{2}$ to 10 minutes.

In transport the boring apparatus folds back over the truck, while the derrick is carried at the side.

Invents Tear-Gas Device to Foil Mail Robbers

ROBBRIES of Uncle Sam's mail safes soon may become a thing of the past if the invention of Dominic Ruff, of Youngstown, Ohio, is adopted by the U. S. government. As soon as a yeggman begins to tamper with a safe equipped with the new safety attachment, the combination breaks open, the inventor claims, liberating a quantity of tear gas or other chemical strong enough to overcome the marauder or put him to flight.

This burglar lock will not operate, however, when the combination is being opened by the proper authorities in the regular manner, the inventor says, so that there is no danger of an accidental discharge of the gases.

The device consists of a very sensitive semicircle of light metal fitted in connection with the combination dial of the safe so that the device will give way at the slightest blow and free the inclosed chemicals. With certain minor changes the inventor claims the same principle can be applied to doors of warehouses and other buildings where there would be no danger to persons in the buildings to be safeguarded.

After reading of a recent mail robbery, Dominic offered the government the free use of his invention. It is now being tested.



Courtesy General Electric Co.

Landing Electric Locomotives in Brazil

WHEN electric locomotives recently replaced steam engines on the Paulista Railway in Brazil, an enormous barge, equipped with a powerful derrick, was required to land the electric traction units from the steamship on which they had been shipped from the United States.

In order to hold the heavy locomotive suspended in the air by a crane without

tipping over the barge, unusual ballast was required. The photograph above shows how this was accomplished, with the huge arms of the crane securely anchored at the back of the barge on which the power house served as ballast.

Eight electric locomotives now do the work which formerly required 12 steam locomotives on this railway.

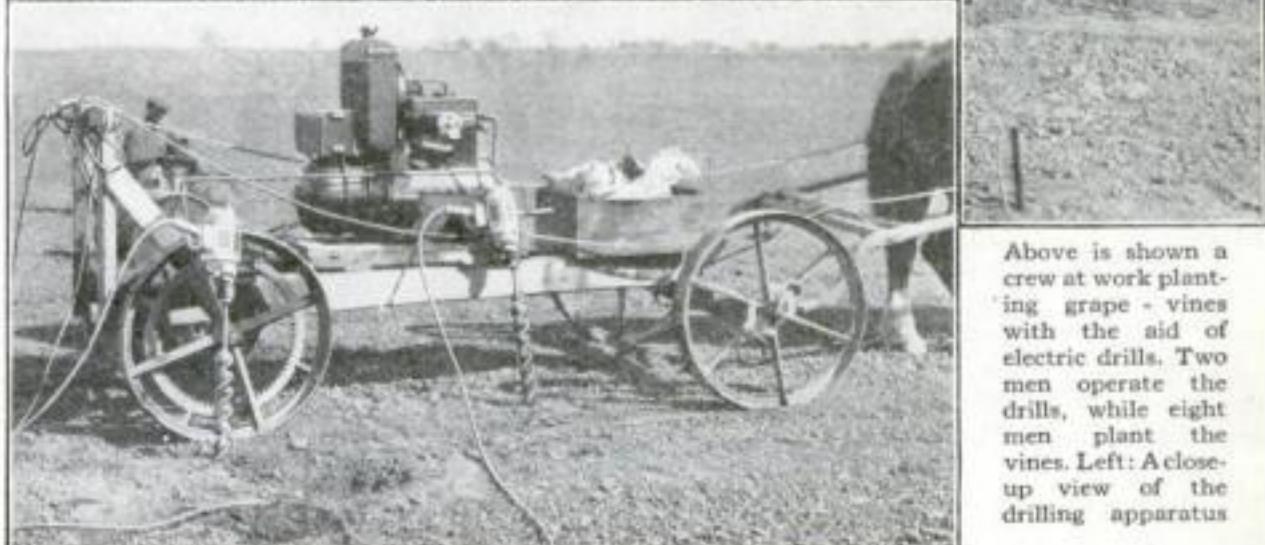
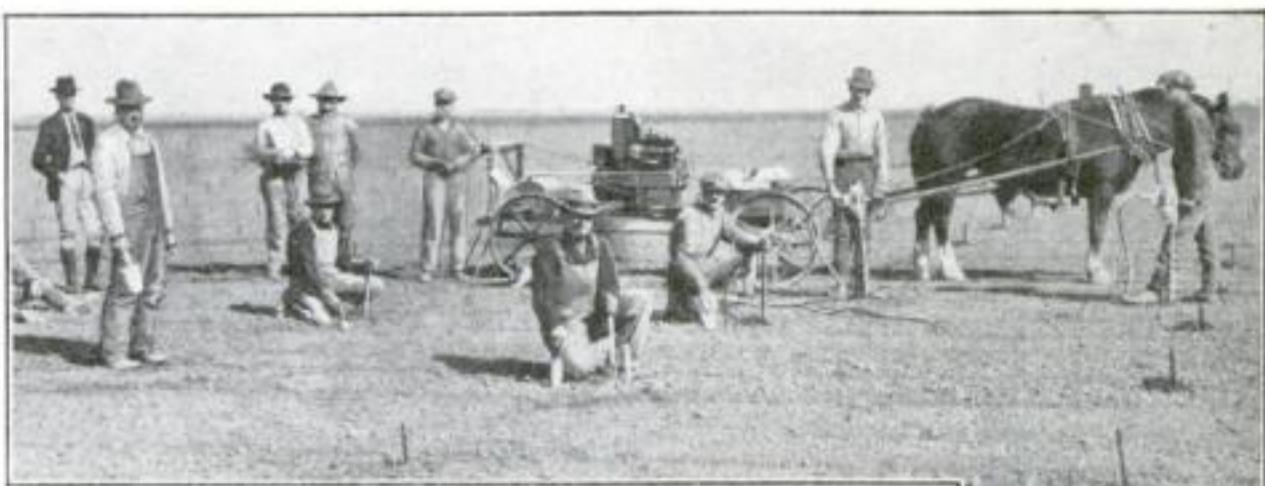
Electric Drills for Planting Grape-Vines

ONE of the most ingenious uses for the portable electric drill was demonstrated recently in the fruit-growing territory of California, where a pair of automatic augers operating from one motor mounted on a small truck bored holes for 60,000 grape-vines in 10 days, resulting in a saving of \$400 a day over hand labor.

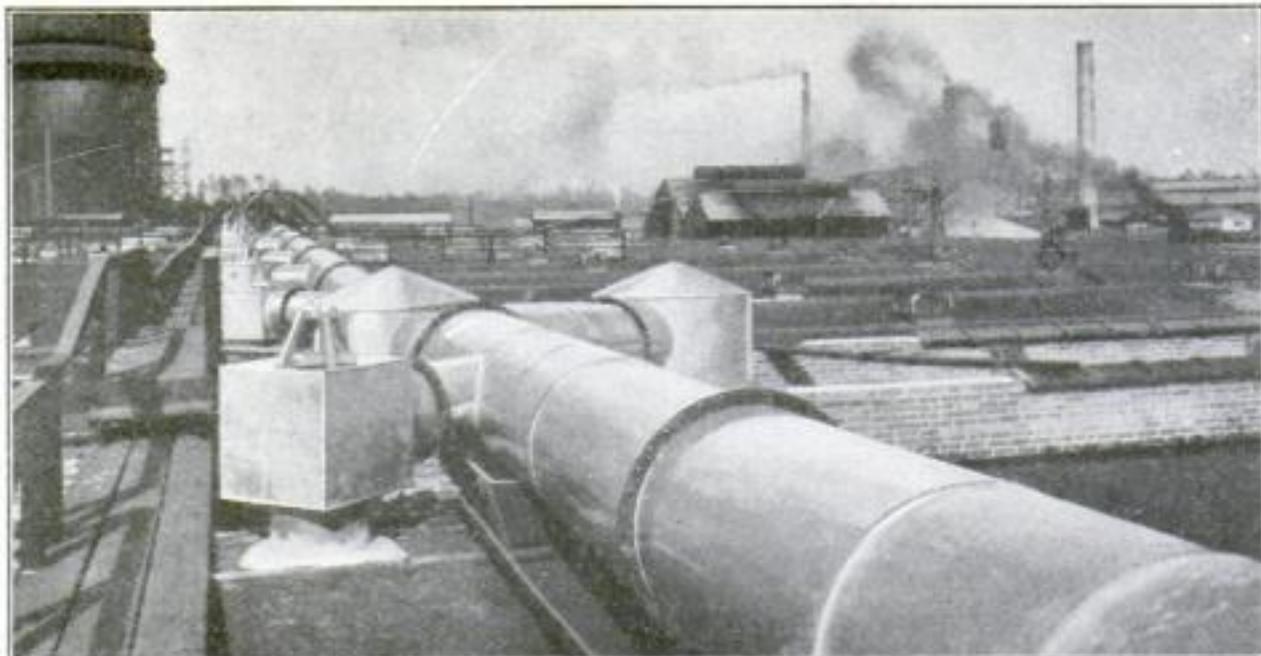
Six thousand holes three inches in diam-

eter and 18 inches deep were dug each day. Each drilling required seven seconds. It was said the auger also crumbled the earth in a most satisfactory manner for filling the holes after the plants were set.

By this new method only two men were required to drill the holes, while eight men followed with the plants, and the cost and time were greatly reduced compared with the previous method.



Above is shown a crew at work planting grape-vines with the aid of electric drills. Two men operate the drills, while eight men plant the vines. Left: A close-up view of the drilling apparatus.



Contest Brings New Lumber-Drying Process

A NEW process of drying lumber, designed to extract the pitch, increase the value of the product, and cut freight bills, recently was made available largely through a prize contest among employees of lumber mills. William H.

Mason of Bogalusa, La., is the inventor.

Two kilns are filled with freshly cut lumber, through which live steam circulates. When the temperature in the kilns reaches the boiling point, additional superheated live steam boils off surplus moisture in the wood, drawing out much of the resins, and removing the turpentine in the form of a vapor. The turpentine is separated readily after these vapors condense because it floats on the water.

After 24 hours the lumber is placed in the usual progressive kilns to complete the drying.

Above is a view of the dry kilns, showing pipes that collect the vapors containing turpentine, and carry them to the condensers.



New Movie Camera Takes 250 Pictures a Second

A NEW high speed motion-picture camera recently perfected in France is said to be capable of taking 250 pictures a second, or of making movies of a cannon ball in flight.

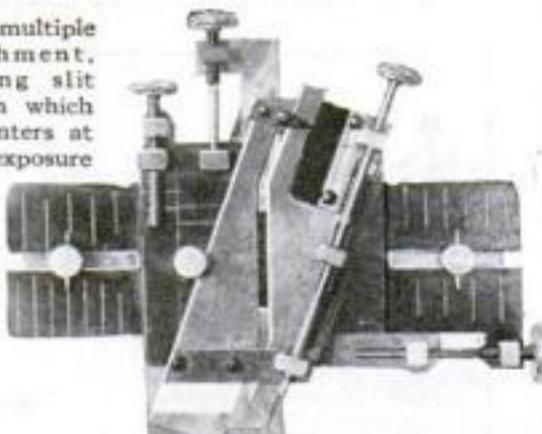
It is said to be constructed on principles entirely new to motion-picture machines. One of its unusual features is a flat mirror set in a socket that is attached to the camera lens in such a way that it can be turned at any angle. This mirror reflects images of the objects to be photographed, and is turned by the operator to follow the movements of objects, such as birds in flight. It is arranged with geometrical exactness so that the focus of the lens is always at a correct angle with the mirror.

M. Labrely, the inventor, believes the machine will catch details of swift movement that never before have been revealed in the movies. He is shown in the illustration above with his machine, demonstrating the mirror attachment.

Many Photographs on a Single Camera Film

MULTIPLE portraits of one person in different poses, or of different persons, all on a single camera film, have been made possible for the amateur photographer by the recent invention of an attachment that shields all but a

The multiple attachment, showing slit through which light enters at each exposure



Neat Elastic Clasp Holds Loose Overshoes



TO PREVENT loose and oversize rubbers from slipping off the shoe at the heel, a neat fastener recently has been invented. It consists of a clasp, one end of which fastens to the upper edge of the rubber at the rear. Through eyes at the other end is inserted an elastic band, which also is attached to a hook. This hook catches over the top of the shoe. Thus the rubber is held firmly, while the elasticity of the device prevents it from interfering with walking.

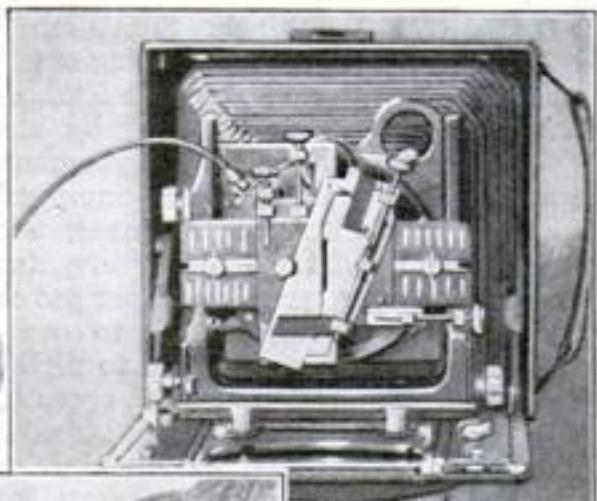
The holder was invented by Rewel S. Rowe and George Winle, of Rutland, Vt.

THE world's largest sea-going electrically driven passenger liner, is soon to be built for service between San Francisco and Honolulu.

a Single Camera Film

narrow section of the film from the light at each exposure.

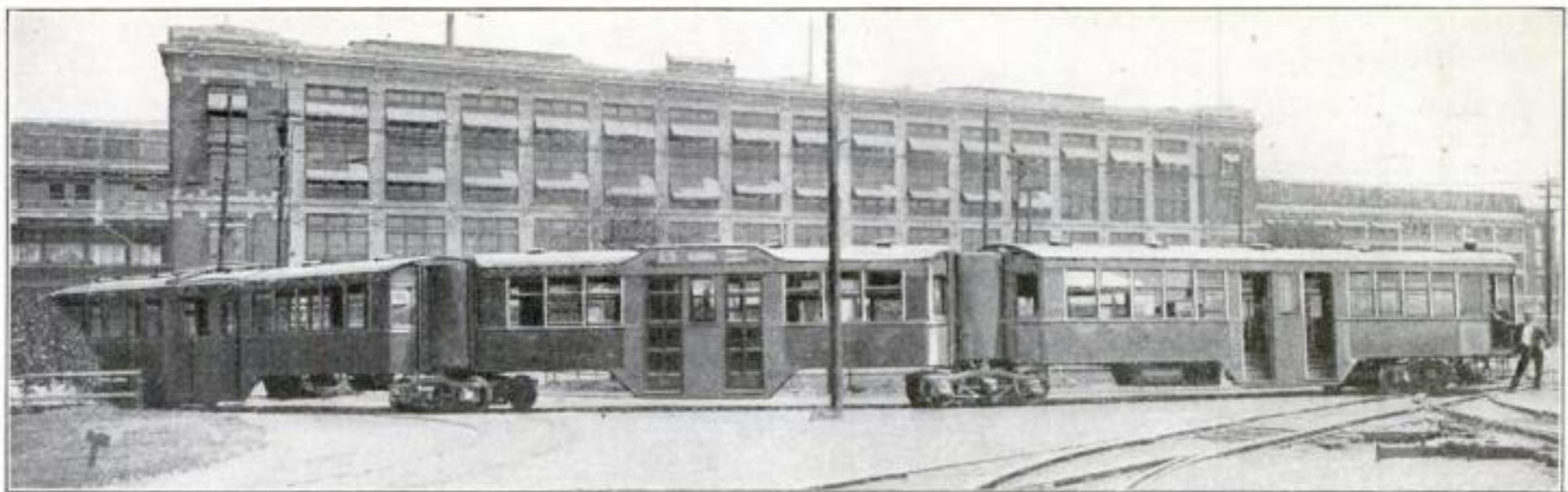
This device is attached in front of the lens and moves from one side to the other. It is automatic to the extent that the opening and closing of the shutter for



Above: The device attached to an ordinary camera. Left: Multiple portraits photographed on a single film

one exposure instantly shifts the attachment to the correct position for the next exposure.

In this way half a dozen different pictures can be made on one film.



Courtesy General Electric Co.

Jointed Three-Car Trains to Handle Detroit Street Traffic

JOINTED trains of three cars each, supported by four trucks, recently were put in operation in Detroit, Mich., as a solution of the traffic problem on Woodward Avenue, said to be one of the most congested streets in the world. Two car trains of streetcars were found

inadequate, and the track capacity would not allow the running of more trains.

The four trucks for the three cars are arranged so that one truck is at each end of the train, while the other two are at the couplings between the end cars and the center car. This provides an unbroken

passage between the cars at all times, on the curves or straightaways.

Only one trolley pole is used—from the roof of the rear car. Double sliding doors in the center of each car provide entrance and exit, and the train cannot be started until all the doors are closed.

Black Lilies from China for Your Garden

BLACK lilies" for American flower gardens are a possibility of the future.

The Bureau of Plant Industry of the U. S. Department of Agriculture is experimenting with seeds of a small lily from 10 to 12 inches high, which grows in the Alpine Meadows of the Sila Pass in China, at an altitude of about 12,000 feet. It is described by the bureau as "well worthy of cultivation on account of its drooping, rich purplish black, bell-shaped flowers, tinged with carmine, which are one or two inches long."

This species was collected by J. F.

Rock, collaborator for the bureau, during his recent exploration of the Yunnan province of China.

The introduction of a number of other promising flowers and decorative shrubs for the American flower lover has been announced by the bureau. Seeds have been received of the *Corokia virgata*, a slender branched shrub, from six to 12 feet high, native of the most northern part of New Zealand, where mild weather prevails. The shining green leaves are downy white underneath, and yellow blossoms, about half an inch across, are borne in three-flowered clusters.

Collapsible Basket Gathers Autumn Leaves

TO SIMPLIFY the task for gathering and disposing of drifted leaves in the autumn, a portable folding canvas basket on wheels recently has been invented.

The basket is constructed of a wire base frame and four side frames, all covered with canvas. The side frames are hinged to the base so that when released they

Below: Raking a pile of leaves into the unfolded container. Right: The basket folded up, with a load, ready to be wheeled away



lie flat, forming a wide canvas carpet on which the leaves can be raked.

When a load has been gathered, the sides are raised and fastened, and the load is wheeled away to be burned. For this purpose a pair of long handles is provided.

Improved Blowtorch Uses New Liquid Fuel

DISCOVERY of a method of producing practically pure butane, a new liquid obtained from natural gas, has led to the perfection of a blowtorch said to combine many advantages over the old type of gasoline torch. Chief of these is the fact that the new torch requires no pump and that it may be used in any position. The torch lights instantly, like gas.

If heated above 34° F., the butane liquid reverts to a gaseous condition. When the torch is used upside down, the liquid tube automatically becomes the gas tube, feeding the burner orifice.

The flame of the butane torch is said to be nearly 500 degrees hotter than the gasoline flame. The torch bowl is made of seamless drawn steel and is filled with about one quart of butane from a check valve in the bottom.

Below 34° F. butane becomes a clear, colorless liquid.



"Talkless Phone" Invented by Deaf Mute

ONE of the most recent devices for use in communication between deaf mutes is a "talkless phone" that conveys messages by means of an alphabet printed on electric-light bulbs. As the operator presses the keys of a special typewriter wired electrically, the corresponding letters are lighted, spelling out the message.

The invention is the work of William E. Shaw, of Cambridge, Mass., who was stricken deaf and dumb by sickness at an early age. He has been working with electrical and mechanical devices most of his life, and claims that deaf mutes miles apart will be able to "talk" with his device.

Three Century Plants Bloom at One Time

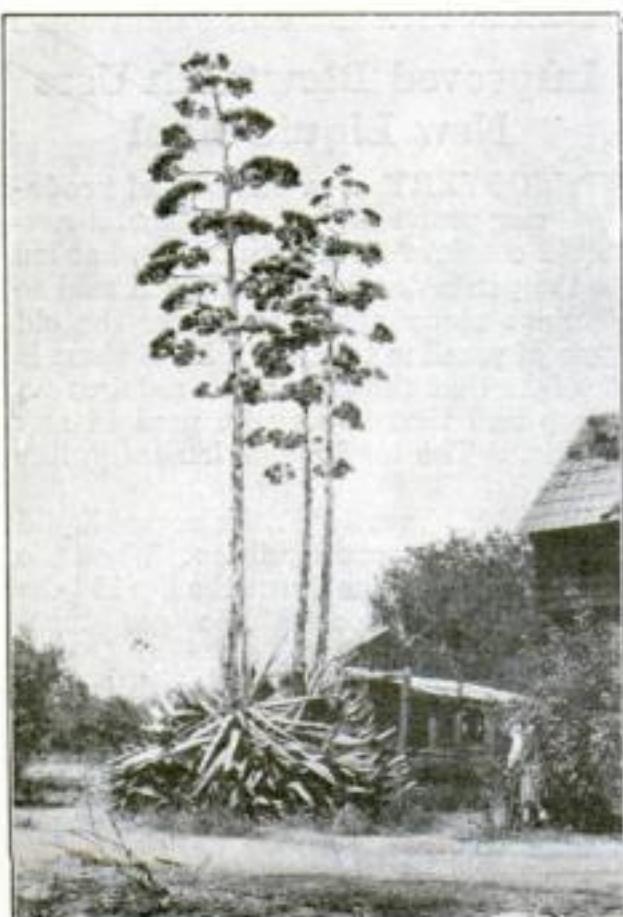
HAVE you ever seen a century plant in bloom? Comparatively few persons have; yet three of them recently brought forth blossoms at the same time in Pasadena, Calif.

The botanical name of the plant is *Agave Americana*. It has large heavy leaves that end in spines to form a guard for the stem.

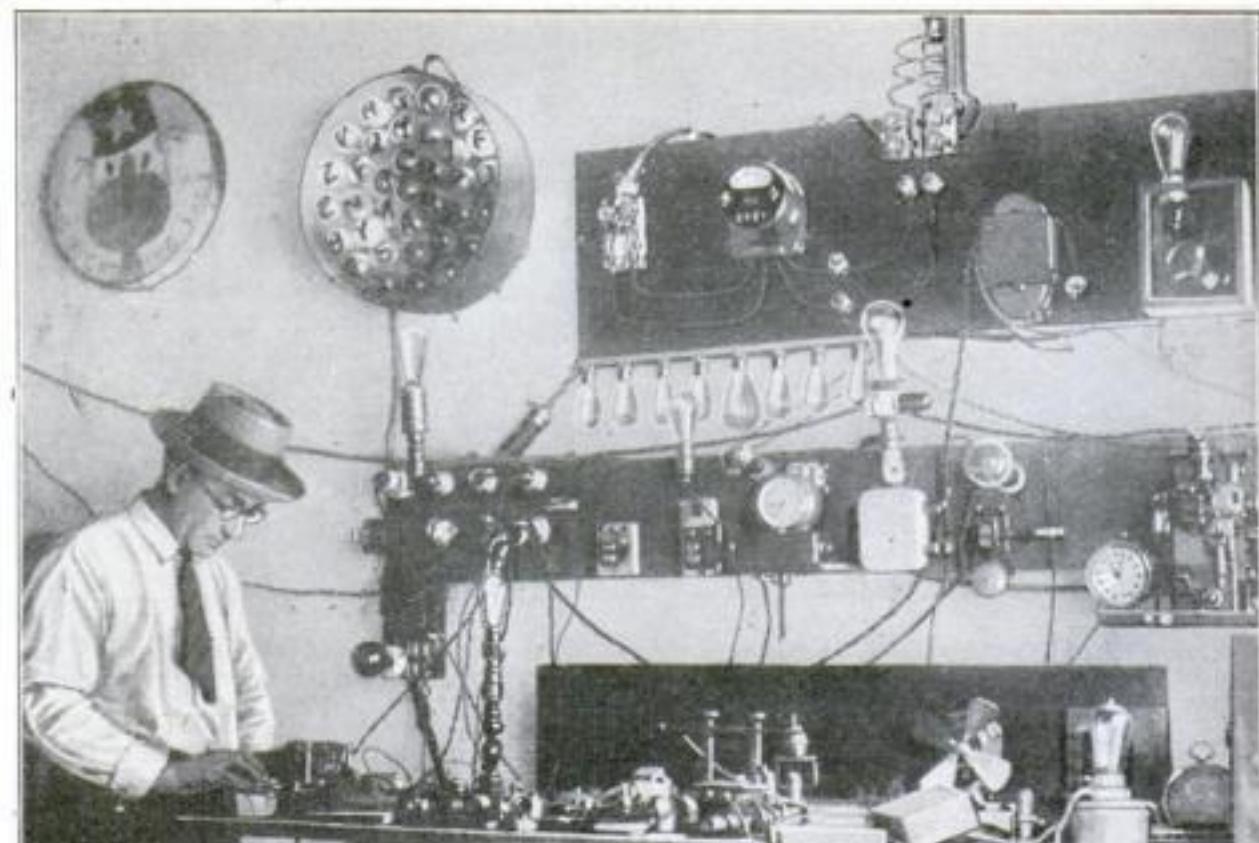
When the plant is beginning to bloom, the giant stem springs from the center, shooting up sometimes at the rate of 1½ feet a day, its smooth straight column resembling a mammoth asparagus. At the top is a spread of smaller stems that carry many golden blossoms upon which bees, birds, and butterflies feast. Its sap, leaves and flowers are all commercially valuable.

The agave blooms only once in its life. When the flowers appear, the huge leaves that have grown steadily for many years shrivel and droop. The flowers are a symbol of maturity that takes the life fluid from the roots and causes the plant to die.

The tallest of the blooms shown in the picture below is 35 feet high.



The three century plants in bloom



The laboratory where William E. Shaw, a deaf mute, has perfected his remarkable "talkless telephone" apparatus for the deaf. Notice the lettered light bulbs at the upper left of the picture



New York Hotel Installs Radio Slot Machines

AT LONG BEACH, N. Y., is one of the first hotels to experiment with coin-operated wired radio apparatus in its rooms as regular equipment for the use of its guests. When a quarter is inserted in a slot, a radio program can be picked up any evening. The receiving apparatus is equipped with either loudspeakers or ear phones, and can be plugged into any lamp socket.

Lightning Rolled in a Ball

A GOLDEN ball of lightning, one of the rarest of Nature's displays, was seen recently near Frankfort, Germany. The man who saw it reports that a golden rain seemed to break forth from the blue sky; then a globe of yellow light sailed on ahead, trailing luminous rays. A clap of thunder followed.

Little is known about these strange balls. Sometimes they float in at windows and attach themselves to metal objects. Occasionally they cling to human beings, and will cause burns of a severe nature.

The Latest Thing in Dolls

DOLLS made to look exactly like the little girls who mother them are an innovation among this year's toys. Artists model the heads of clay, cover them with stockinette, paint them, and attach silky goat's hair.

Then, when the child has grown up, the mother has a life-long image of her daughter.

Tiny Compass Is New "Jewel" for Finger Ring

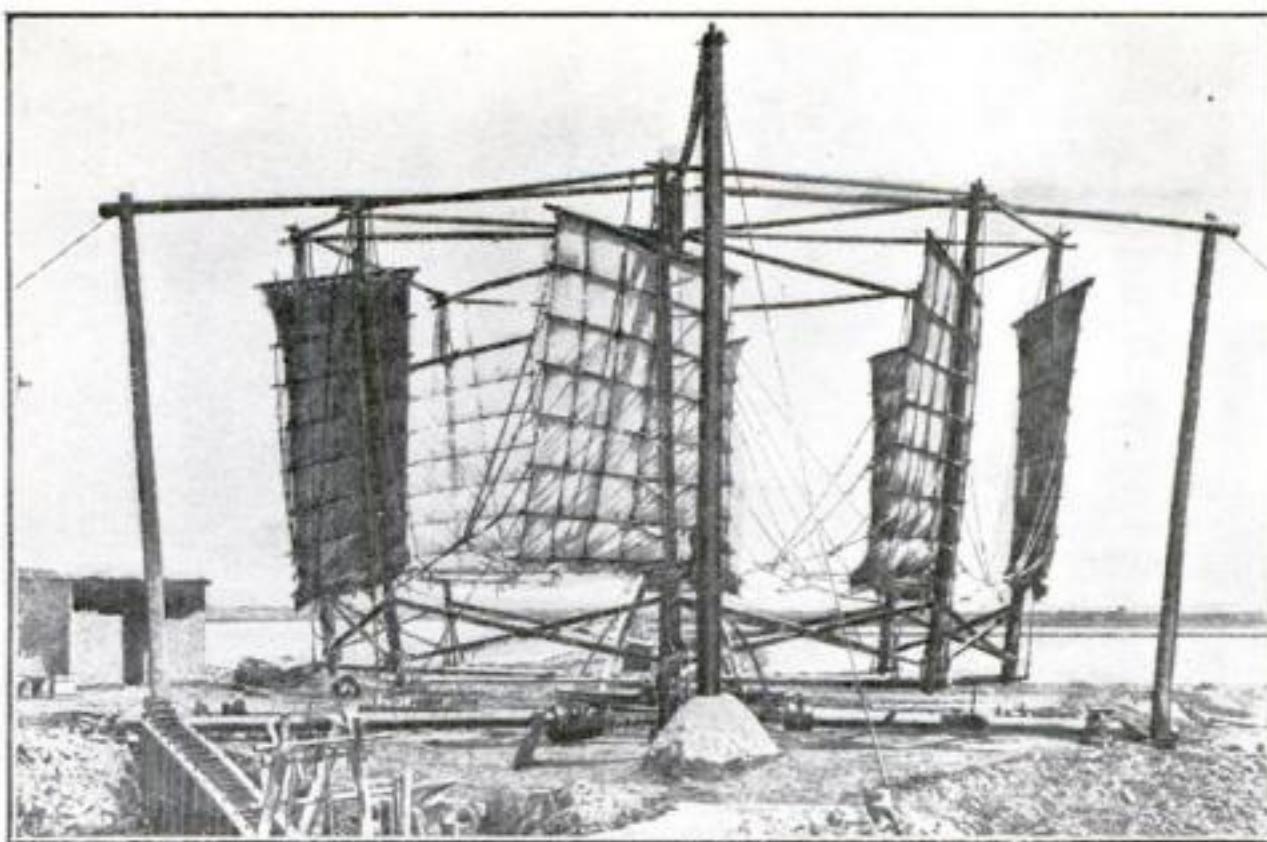
A FINGER ring with a tiny compass set in place of a stone forms a novelty that is said to be useful not only to the hiker, but also to electricians in testing high-voltage lines and in examining armatures and stators in motors to determine their positive and negative poles.

In appearance it is an attractive gold ring, with a little circular window in the top through which the needle of the midget compass is easily seen. The compass is rigidly constructed so that the jarring of ordinary wear as a finger ring will not impair its accuracy in any way.

It is said to be the smallest ring compass ever made.



Tiny compass set in finger ring



A relic of primitive engineering, this bulky windmill of lateen sails is still in use at Tientsin, China, to draw water for irrigation purposes. The sails revolve with the wind.

Deer Takes an Auto Ride

IN THE woods near Sheridan, Ore., a couple of deer recently tried to cross a road on which an automobile was approaching. One leaped and landed in the lap of the driver, and was slightly injured. The motorist drove the animal home with him.

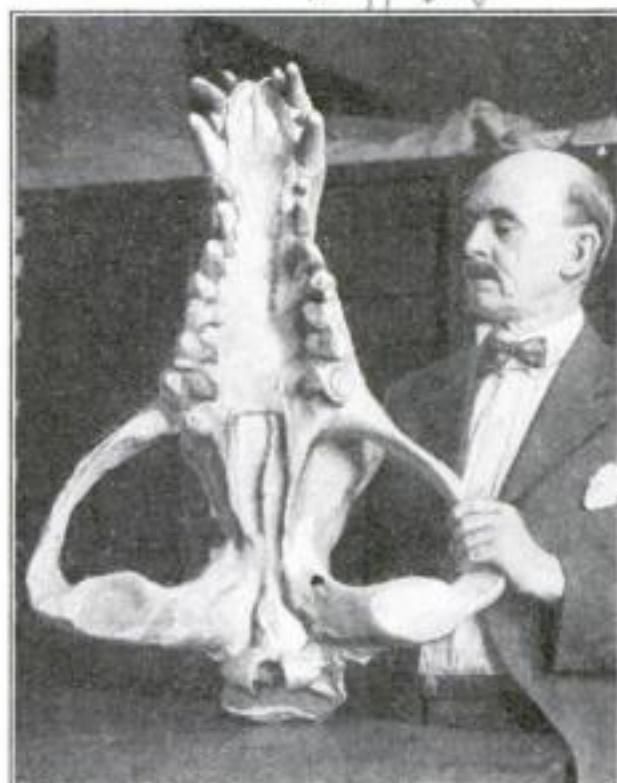
Folding Hat Umbrella Fits into a Handbag

AS A SUDDEN downpour of rain no longer need hold terror for the woman who is wearing an expensive new bonnet.

As a protection against showers a waterproof hat cover, recently designed, may be carried in the handbag, quickly opened, and tied over the head and hat. It is made of heavy oiled brown parchment. When closed, it looks like a neatly folded heavy envelope. Strings are attached to keep it from blowing off while in use. The protector may be used several times if it is carefully dried after use.



Hat protector tied under the chin



Prehistoric Creature Had a Three-Foot Skull

HERE is a cast of the skull of the largest flesh-eating animal that existed in the prehistoric Eocene period. The photograph shows it in the hands of Dr. James Gidley of the Smithsonian Institution, Washington, D. C.

The original skull, which is almost priceless, was found by an expedition under the direction of the institution into the heart of the Gobi Desert of Mongolia last year. Although more than five million years old, no name has been given yet to this animal by scientists. With a skull about three feet long, the entire size of this giant can easily be imagined.

Skeletons 15,000 Years Old

SKELETONS of three prehistoric Cro-Magnon men and one woman, believed to have lived in southern France near Macon more than 15,000 years ago, were discovered recently by Prof. George Grant MacCurdy of Yale. All have square, receding chins, flat noses, and huge eye cavities.

Ancient Irrigation Plant Run by Wind Power

ODD examples of the comparative slowness and crudity of ancient tools and machinery still are found in many parts of China. One of these is a primitive sail windmill which is used today at Tientsin to lift water from a well for irrigation purposes.

To obtain the power to lift the water, lateen sails are fastened perpendicularly on a rough, revolving framework, forming a very cumbersome wind machine to operate the hoist.

Beavers Mend an Old Dam in Pennsylvania

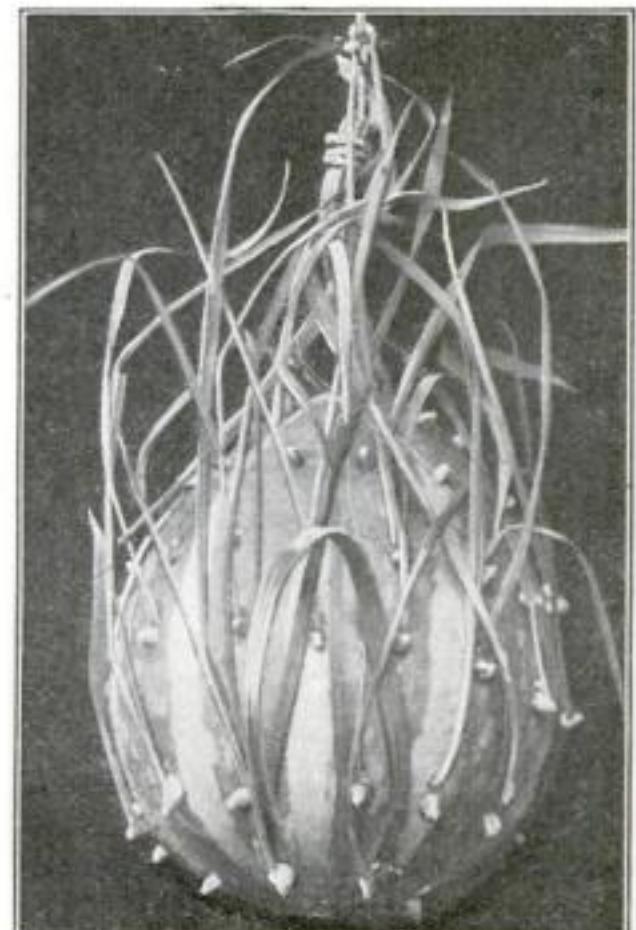
FIshermen visiting Moqueto Creek near Bellefonte, Pa., recently discovered that a colony of beavers, working quietly, had mended a breach in an old dam that had been in need of repair for several years. The accommodating animals had made a good job of it.

Another enterprising beaver colony has been at work on a dam in a creek running through the yard of a residence within the city limits of Duluth, Minn. The owners have been too interested watching the work to interfere.

An Odd Indoor Garden Can Be Made Easily

A NOVEL form of indoor garden that is inexpensive and attractive may be made from a ripe pumpkin, gourd, or vegetable marrow.

Grains of wheat or oats and other seeds are pushed into the outer skin over the entire surface. They should be embedded only half way. The vegetable then should be hung in a light, warm room, where the grains soon will be found to sprout freely, as shown in the photograph. The plants will grow without water, because the natural juice of the fruit supplies the moisture necessary for their sustenance.



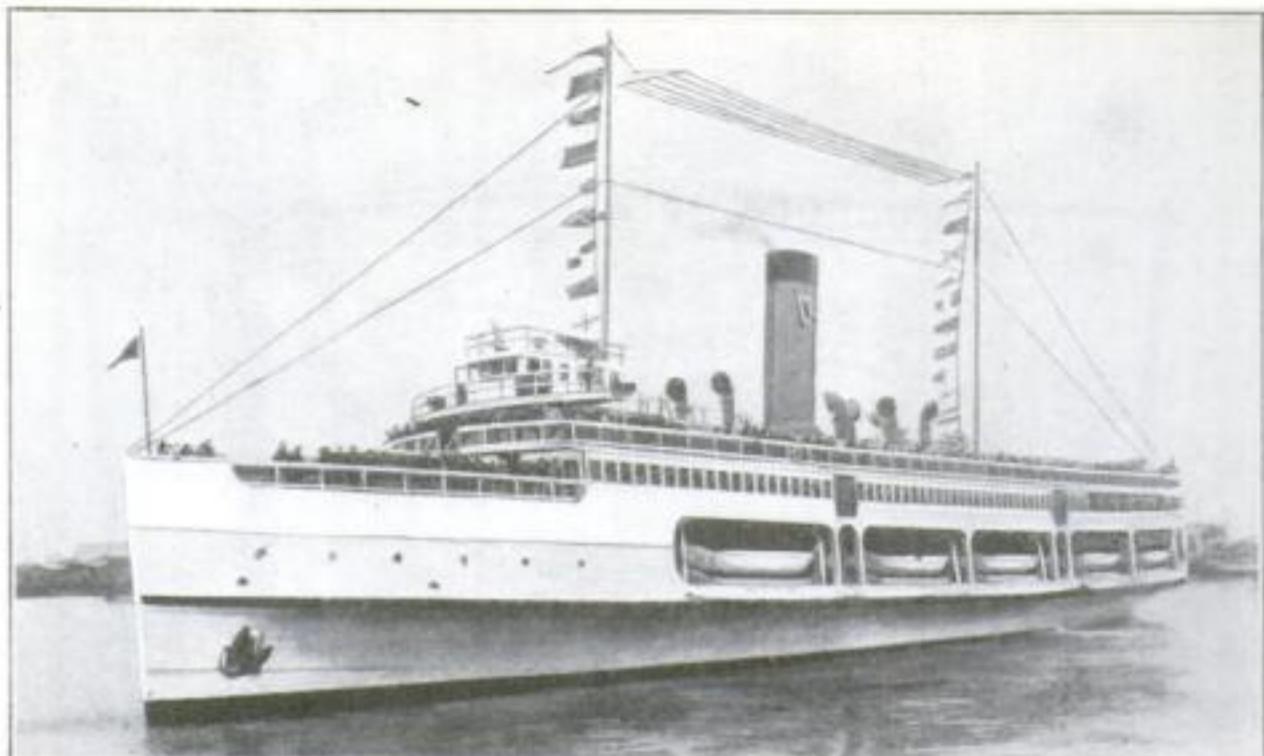
A garden of grain hung indoors

Life-Boat Launching Made Easier on New Ship

THE difficulties usually encountered in attempting to launch life-boats from the upper decks of steamships in heavy seas has led to an unusual new arrangement for installing the boats nearer the surface of the water.

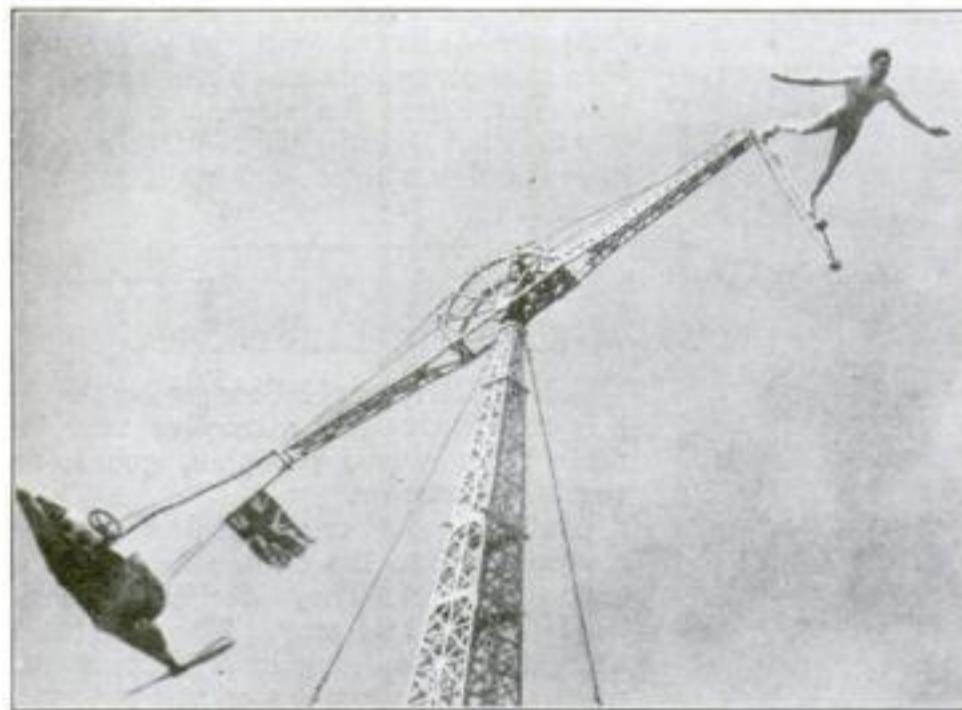
Instead of being suspended from davits on the upper decks, the life-boats are placed in niches in the sides of the vessel just below the main deck. This new plan has been incorporated in the liner *Catalina*, recently built for intercoastal trade in the Pacific. It is said not only to make the boats more accessible to passengers in emergency, but to afford greater safety in lowering them.

The accompanying photograph shows the *Catalina* on her maiden voyage, 90 days after she was launched at a shipbuilding plant at Los Angeles, Calif.



The liner *Catalina* showing unusual arrangement of life-boats below the main deck

Hangs by Feet on Aerial Merry-Go-Round



The acrobat whirling through the air on a revolving beam

HANGING by his feet and whirling in dizzy circles on an aerial merry-go-round, an acrobat named "Mirano" performs one of the most perilous stunts ever attempted, at Southend, near London.

The man "works" at one end of a high revolving beam on a steel tower. The crosspiece is revolved swiftly by an airplane at the other end.

A Vast Army of Centipedes on the March

THE migration of a vast army of "thousand-leggers," marching through the desert, is the unique sight reported by Professors J. M. Thuringer and O. B. Jacobson of the University of Oklahoma.

They were driving through a desert stretch in New Mexico, when they observed small black objects along their

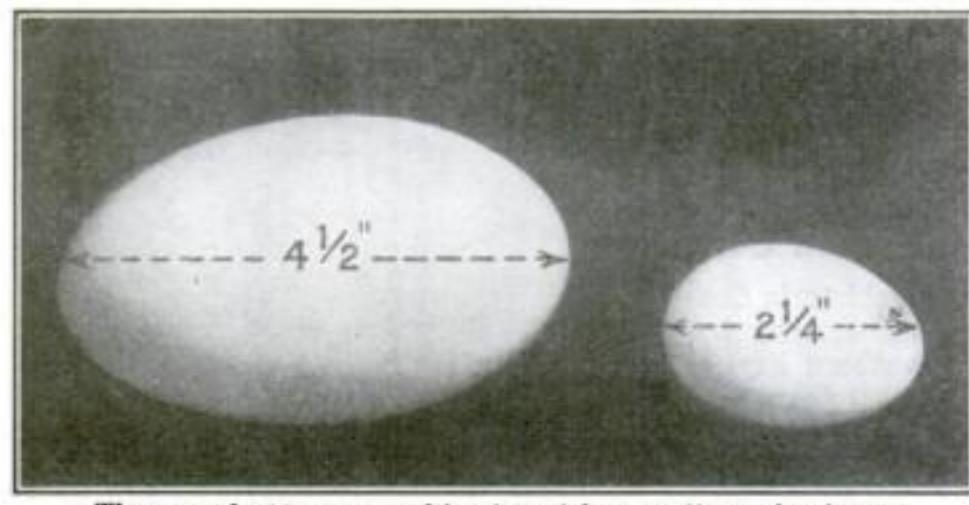
path. When these became so numerous that the wheels of their Ford ran over one every yard, they stopped to examine them. The creatures proved to be large centipedes, all apparently moving in the same direction. What they were doing in the desert, where they came from, and where they were going, remained a mystery.

Largest Hen's Egg Weighs Eleven Ounces

WHAT is believed to be the largest egg ever laid by a hen recently came into the possession of the Poultry

Department of Oregon Agricultural College. The egg weighs 11 ounces and measures $8\frac{1}{2}$ by 11 inches in circumference, five times the circumference of an ordinary egg. It is about $4\frac{1}{2}$ inches long, or twice as long as the average hen's egg.

The hen that laid it is a single-comb Rhode Island Red, and its proud owner is S. T. White of Corvallis, Ore.



The record egg compared in size with an ordinary hen's egg

"Steering Wheel" for Sled also Is a Brake

A NEW attachment for the child's coasting sled serves not only as a means of steering and braking, but also aids in propelling it. It consists of a pivoted vertical rod mounted on the forward part of the sled and fitted with a cross-bar handle at the top. The bottom



Steering post and brake in one

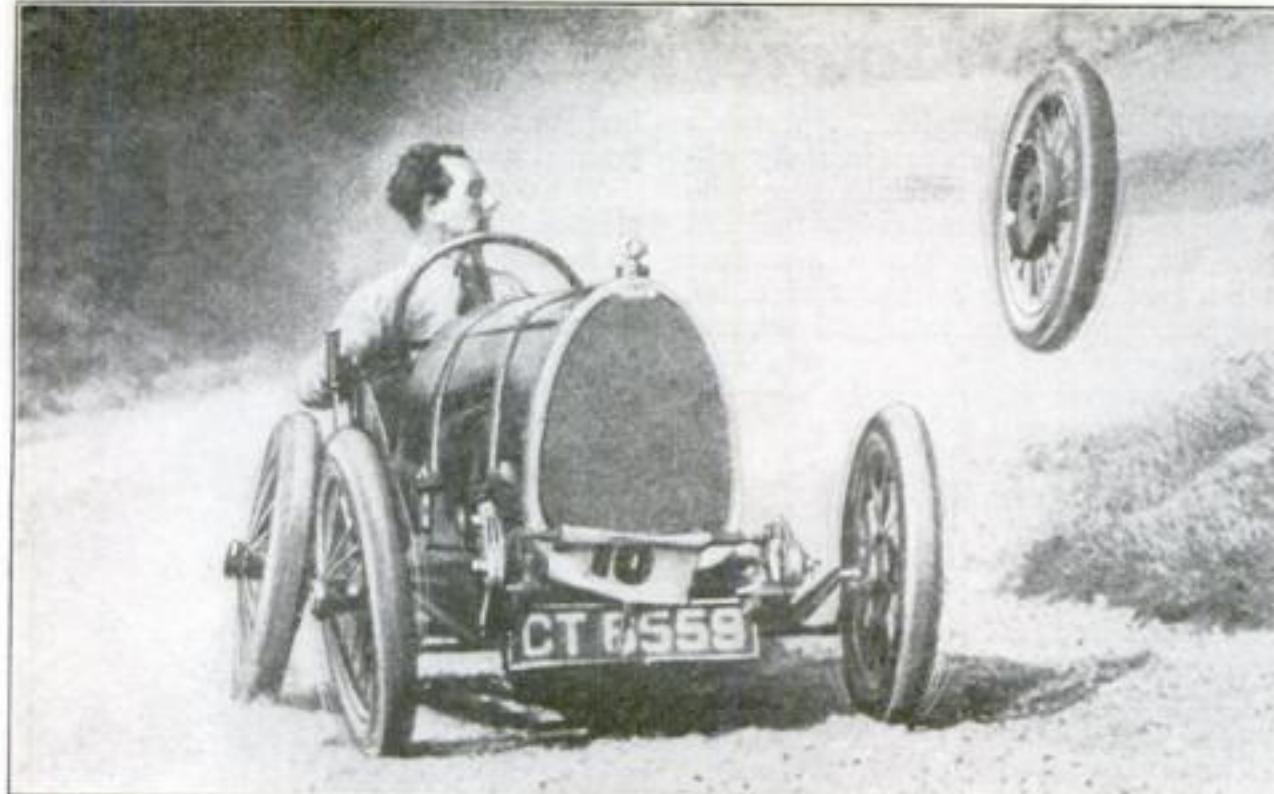
end of the rod is pointed and tipped with metal. The sled may be steered by moving the handle from side to side.

The rod will act as a brake when pushed down firmly into the snow. By moving it forward, thrusting it downward, then pushing the point back by a forward movement of the handle, a child may propel the sled forward without using his feet for motive power.

Bottle Sets Speed Record

THE speed record for floating bottles is said to have been broken by one that was thrown overboard from a U. S. Hydrographic Survey vessel and was picked up recently by a French merchant. It had traveled approximately 1500 miles in 328 days.

The bottle, sealed and stamped by the U. S. Navy, contained a parchment giving the name of the vessel from which it was dispatched, the latitude and longitude, and a request to return the message.

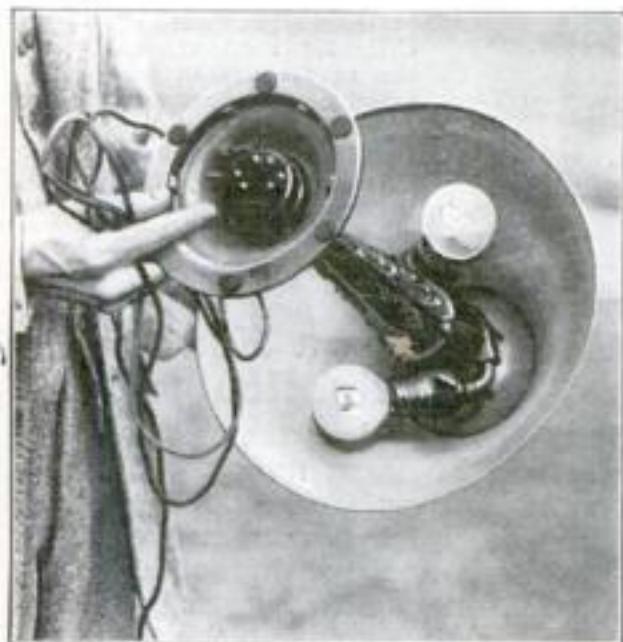


Just as the wheel flew off, the camera caught this remarkable photograph

Lamp Pedestal Serves as Radio Loudspeaker

OF THE many types of radio lamps designed in recent months, one of the most ingenious uses the pedestal of the lamp as a loudspeaker horn.

The head phone is placed at an opening in the bottom of the pedestal, as shown in



The head phone inserted in the lamp

the accompanying photograph, and the sound is carried upward and amplified through the hollow pedestal. At the top the sound is reflected by the shade, which is shaped like an inverted bowl.

The lamp contains two light sockets and is wired so that it can be used simultaneously for lighting a room and for bringing in broadcast music and entertainment.

The lamp's design makes it an attractive fixture for the living-room.

New Uses for Castor Oil

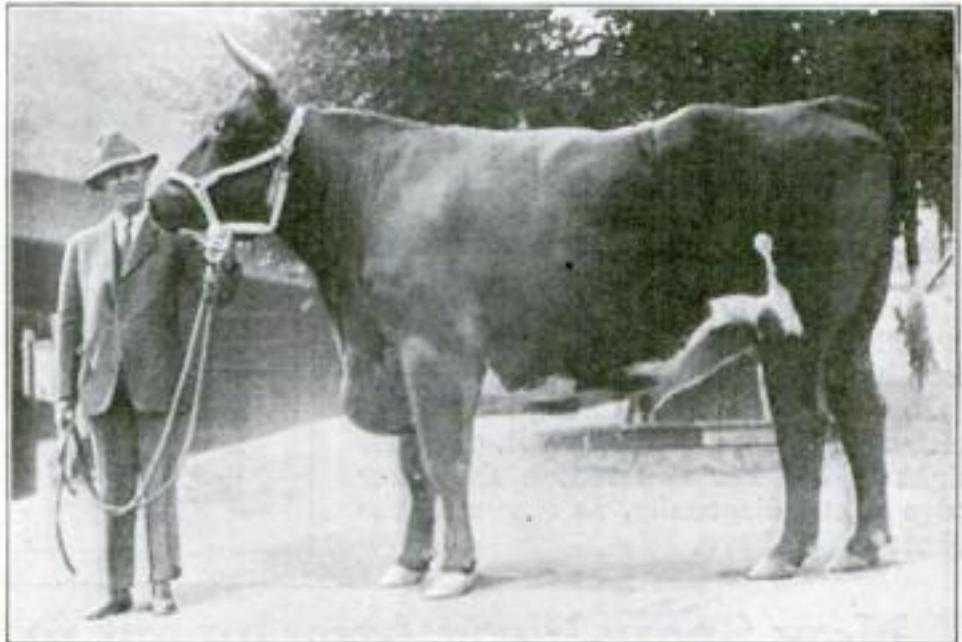
RAILWAY chemical engineers have produced a special lubricant from castor oil, which now is being used with great success on the Chinese Eastern Railway, according to reports. It is said to be economical and efficient as a car lubricant.

Castor oil is coming into extensive use for technical and medicinal purposes. In China it is used also as food.

World's Largest Steer Weighs 2834 Pounds

A STEER taller than a man, and said to be the largest in the world, was one of the interesting exhibits at the British Empire Exhibition at Wembley, England.

The steer is a pure Durham, and was raised on a ranch in Alberta, Canada. He stands 18 hands high, is 10½ feet in girth, and weighs 2834 pounds—nearly a ton and a half. He was the center of much interest from cattle experts and curiosity seekers.



The giant steer on exhibition. He stands six feet high

Comparison with the man in the photograph gives an idea of the immense proportions of this magnificent animal.

Whale Is Model for

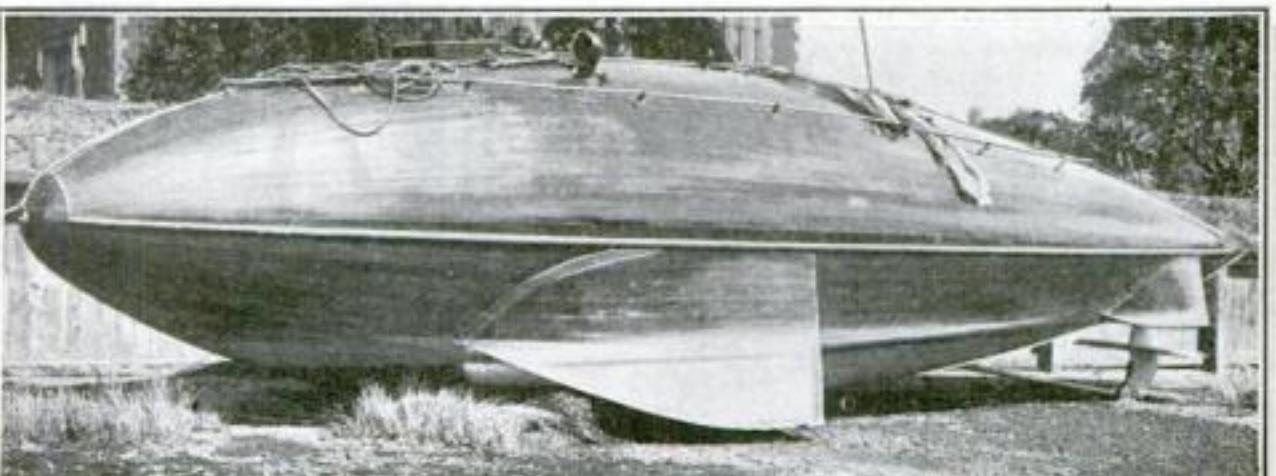
RESEMBLING a whale or submarine in appearance, when out of water, a new type of speed boat under construction in England is expected by its designers to set new speed records when it is tested soon on the Thames River.

The lower part of the hull is of hydroplane design, with a lifting step to raise the hull when the boat is traveling at high speed, and to decrease the water resistance.

Unusual Speed Boat

The deck work is streamlined. For speed driving in heavy seas, the pilot is almost entirely inclosed. Only his head is exposed above the rounded deck.

One of the many novel features of the boat is a tail plane fitted across the rudder just above the propeller. This plane is designed to function in connection with the gliding step under the hull. A 450-horsepower engine is expected to propel the craft at record-breaking speed.



The novel speed boat as it appears high and dry, showing its whale shape

Camera Clicks as Axle of Racing Car Snaps

ONE of the most remarkable accident pictures ever taken, showing the rear wheel of a racing car in midair after leaving the axle, was snapped recently by a photographer in Wales.

Raymond Mays, a race driver, was piloting the car at a speed of 60 miles an hour, in a speed hill climb held at Caerphilly, near Cardiff, when the rear axle of his car suddenly broke, throwing the left rear wheel high in the air.

At this instant the camera shutter clicked, and the photographer obtained the unusual photograph reproduced at the left. Notice the wheel whirling in the air, as the driver turns to see what has happened.

Fortunately, the car kept on the road and Mays was able to come to a stop without injury to himself. The car was only slightly damaged.



An anti-glare protector attached to the windshield. The driver looks beneath it

An Anti-Glare Eye Shield

PROTECTION of the driver's eyes from the glare of sunlight during the day, and from bright headlights at night, is claimed for a new non-breakable shield that is hung from a swinging arm attached to the top of the windshield. It is said to diffuse the brightest light to a soft, blue glow.

Instead of looking through the protector, the driver looks under it, or to the right of it. For this reason the lower edge is cut diagonally, as shown in the photograph above.

Sidecar Motorcycle Is Fire Engine

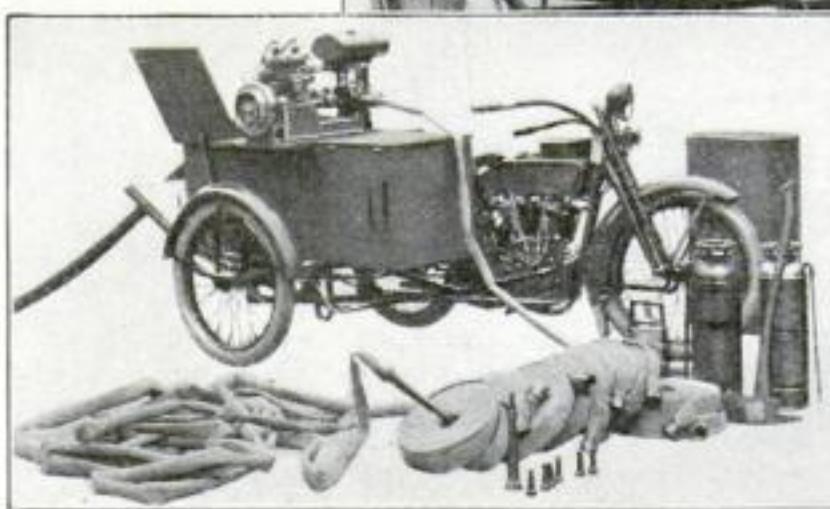
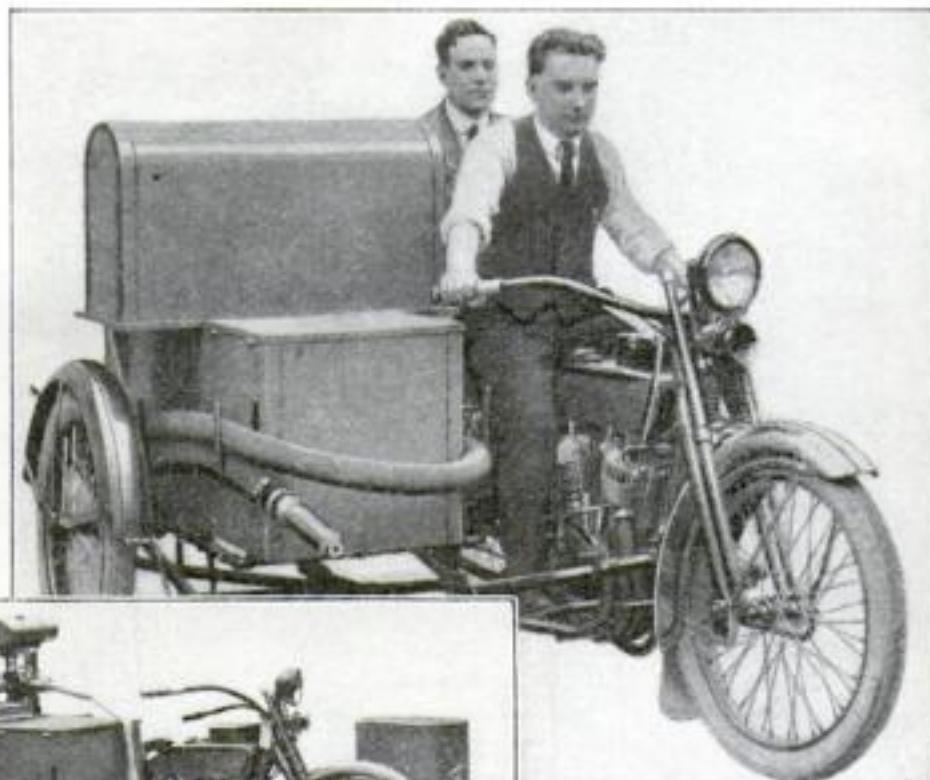
A SPEEDY and serviceable portable fire-fighting apparatus recently devised is mounted on a special motorcycle sidecar. The outfit consists of an inclosed two-cylinder gasoline pump mounted over a case containing lengths of coiled hose, nozzles, chemical extinguishers, and fire axes.

The pump is of the suction type, drawing the water supply from a well, stream, or lake in which the hose is placed. It is especially adapted for rural communities and forest fire service.

The linen fire hose, $1\frac{1}{2}$ inches in diameter, is constructed to stand a working pressure of 200 pounds a square

inch, or a bursting pressure of at least 800 pounds a square inch.

The outfit may be set up and pumping started in a very few minutes, and is said to be capable of sending a 50- to 60-foot stream through four lengths of hose, each of which is about 500 feet long.



Here is a speedy sidecar fire-engine, designed especially for rural communities or for use in forest-patrol work. Above a large case containing the fire-fighting apparatus is mounted a two-cylinder gasoline suction pump. The photograph at the left shows the complete equipment

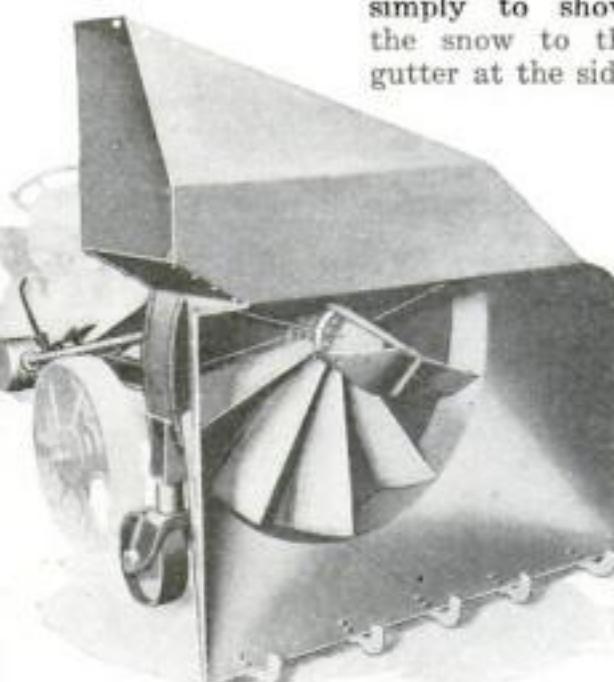
New Snow-Plow Attachment for Tractors

FOR the speedy removal of drifted snow from country roads, as well as from city streets, an ingenious new snow-plow attachment for Fordson tractors has been perfected for service during the coming winter.

The design of the plow is said to enable a Fordson with a crawler tread, or weighted, tired wheels and chains, to maintain a speed of $1\frac{1}{2}$ miles an hour in a snow depth up to $2\frac{1}{2}$ feet, clearing a single track down to two inches above the road surface. An ingenious pivoted anchorage causes the plow proper to rise and fall with surface irregularities.

Power is transmitted through a heavy propeller shaft and

universal joint to a pair of $2\frac{1}{2}$ -inch face gears carrying the rotary plow. The propeller of the plow is of heavy gage steel. It has an auger-shaped center, which bores into the snow, and vanes of unusual pitch, which suck and whirl the snow through a short blow tunnel to the side of the road for a distance of 30 feet. For city work, the plow can be adjusted simply to shove the snow to the gutter at the side.



Above is shown the snow-plow attachment for Fordson tractors. The center of the propeller is auger-shaped to bore into drifts, while the larger vanes suck in the loosened snow and throw it to the side through a funnel



The new tractor snow plow at work

Auto Drives a Houseboat on Lake Michigan

RESIDENTS along the north shore of Lake Michigan near Chicago were startled not long ago by the appearance of a palatial houseboat that traveled at an unprecedented speed for such a craft, yet produced no noise nor smoke to indicate the presence of an engine aboard.

The mystery was solved when the boat put to shore. It was found that the craft, owned by a Chicago banker, was driven by his automobile, which was placed ingeniously on the aft deck between two paddle wheels.

The owner enjoys motoring on the water, as well as on land, simply by driving his car aboard the boat on a gangplank.

The automobile is guided along grooved runways to a position between two eight-foot paddle wheels, where it is anchored. The rear axle then is jacked up to lift the tires free of the deck, and the engine is connected with the paddle wheels by means of link chain belts running between spurred sprocket wheels attached to the rear hubs of the car, and larger sprocket-wheels keyed to the ends of the paddle wheel shafts. The attachment, it is said, can be completed in 10 minutes.

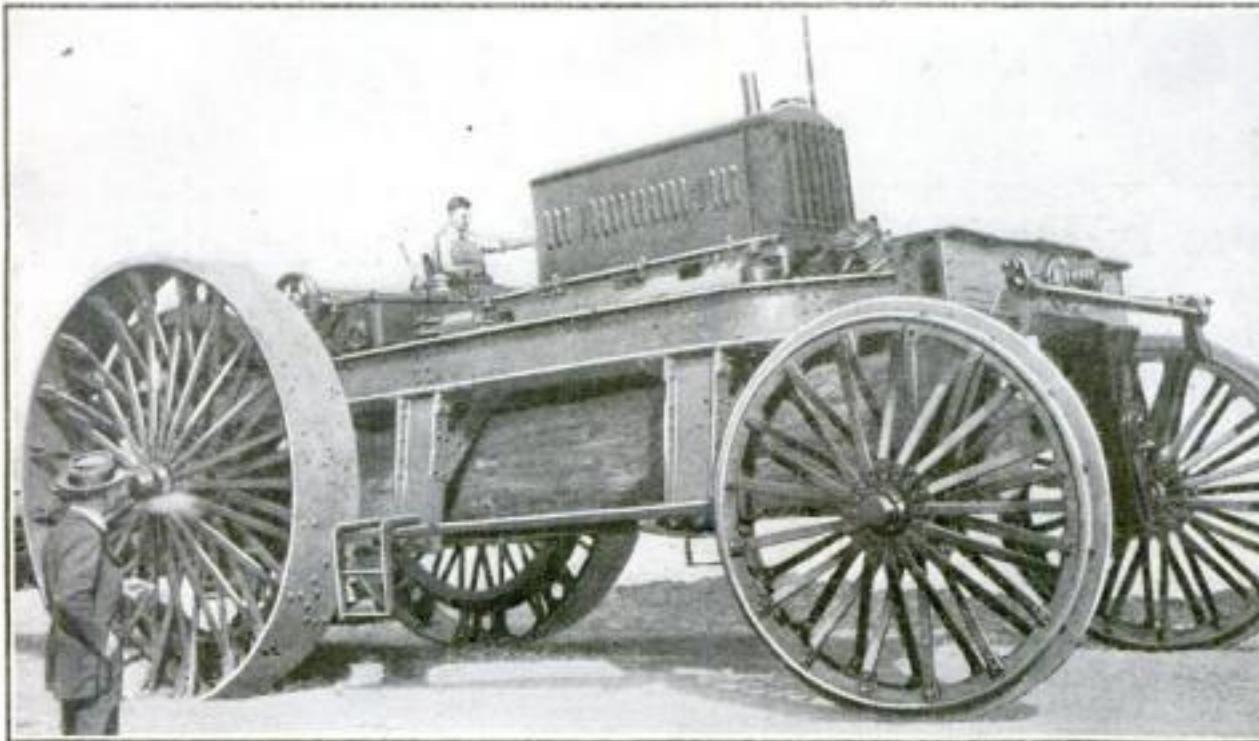
POPULAR SCIENCE MONTHLY will be glad to furnish a list of radio and tool manufacturers whose products have been approved by the Popular Science Institute of Standards.

The Largest Tractor in the World

IN THE forests of the Northwest the tractor is demonstrating its ability to take the place of the horse-drawn lumber wheels. The usual practice, after the huge trees are cut down and stripped, has been to haul away the logs by suspending one end of them between two large wooden

wheels while teams of horses drag them.

To do this work faster and more efficiently, a huge tractor, said to be the loftiest in the world, was constructed. An enormous log may be suspended beneath it. The tractor is so tall that a Ford car can pass beneath it with ease.



The logging tractor, showing its tremendous size compared with that of a man

New Mail Trucks Armed like Fortresses

HEAVILY armored mail trucks, which are declared to be virtually bandit-proof, soon will be put into service by the Post Office Department in every city of the United States where a Federal Reserve bank is located, according to a recent announcement by Postmaster-General New.

Seven of these trucks, with bullet-proof bodies and steel-protected windshields, already are in operation in two or three of the larger cities, the postmaster said. Each truck is manned by a driver and two guards. The steel sides of the body contain bullet-proof shutters, affording

vantage points for a hot return of rifle fire in case of an attack by bandits. Steel doors and a tail gate that unlocks only from the inside, add to its impregnability.

Another interesting feature of these traveling fortresses is a siren that blows a shrill blast in case of emergency, and automatically continues to sound the alarm until assistance arrives.

Recent tests of the trucks at Fort Myer, Va., are said to have demonstrated their effectiveness. They were designed as a result of a series of daring mail robberies.

Six-Wheel Auto-Bus Seats 27 Passengers

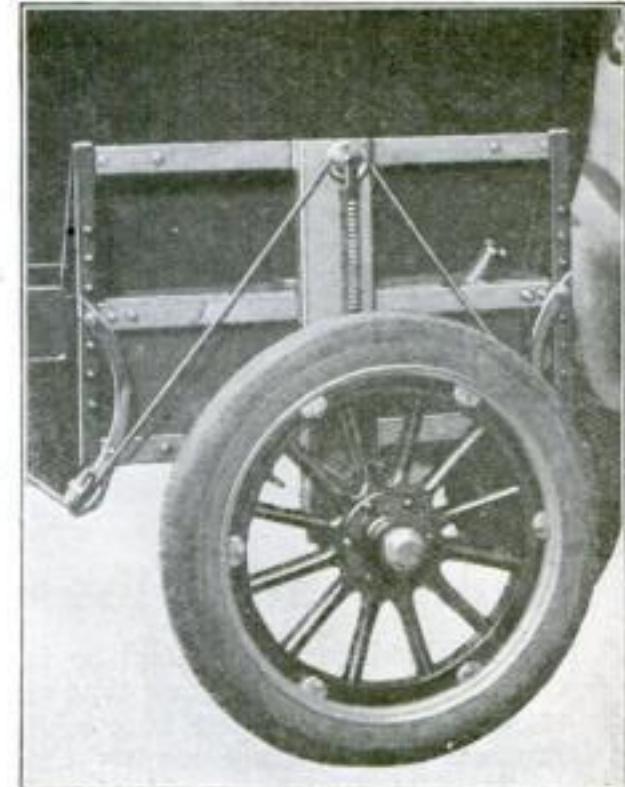
A VEHICLE that is said to mark a revolutionary step in the development of truck and bus manufacture has been designed by engineers after exhaustive tests. It is a new six-wheel auto-bus, driving and braking on the four rear wheels, which are assembled in one unit, similar to the trucks on railway cars. It has a seating capacity of 27 passengers and is said to reduce road impact to one fourth of that produced by the

ordinary four-wheel bus, giving greater riding comfort over rough roads.

The makers claim it embodies more advantages than any previous type. Charles M. Schwab, one of the country's leading financiers, is chairman of the board of directors of the Philadelphia corporation which is manufacturing the new vehicle.



A huge six-wheel motor-bus recently designed to accommodate 27 passengers. It is said to make riding comfortable over the roughest roads in the country



Fifth-wheel attachment at the rear for moving a car sideways out of a parking jam

Fifth Wheel for Parking

TO PROVIDE easy egress from a parking space where other cars before and behind do not allow enough room for backing and turning, Ingemar K. Rystedt of Dayton, Ohio, has invented an unusual spare-wheel attachment that may be lowered to the pavement for wheeling the end of the car sidewise so that it may be backed into the street. The spare wheel is mounted on a special carrier equipped with a specially designed jack. Power is transferred to the fifth wheel by cable and pulley.

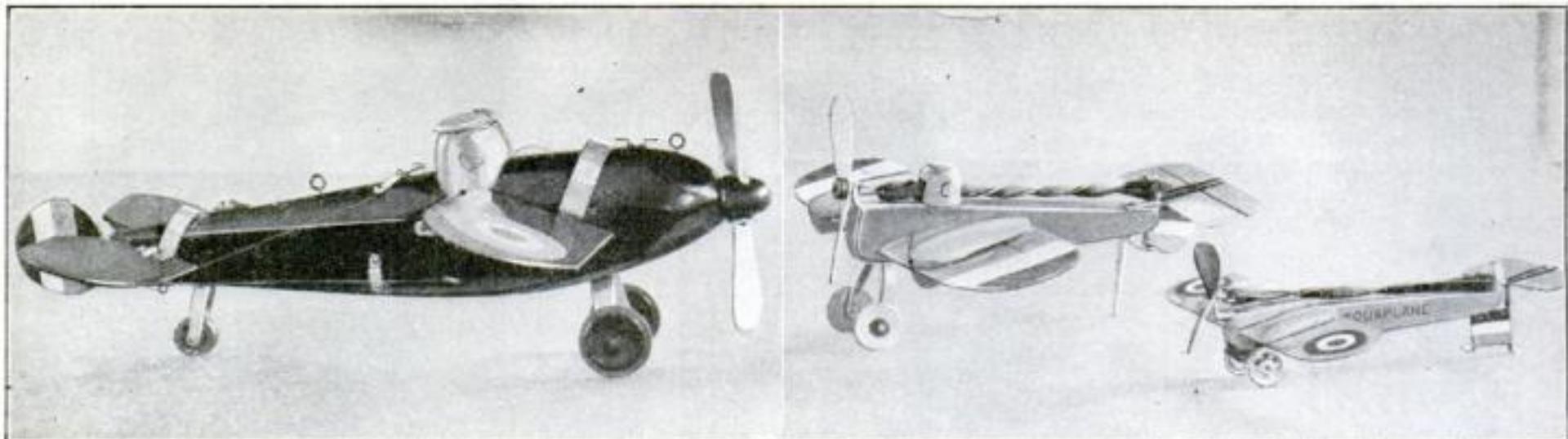
This Gas Can Won't Spill



The flexible hose nozzle of the can simplifies tank filling

A GASOLINE can designed essentially for carrying gas to a stranded car, also is a handy article for everyday use. It is provided with a flexible tube that permits easy filling, without spilling, where the gas tank is hard to reach. Each end of the tube has a screw.





Under-Water Monoplane Is Designed as a Speedy War Machine

A SPEEDY submersible aquaplane is the latest proposal for a new type of war machine. Judging from successful performances of miniature models the machine is said to be capable of performing under water all the tricks that an airplane does in flying.

Three of the models are shown above.

The design of the aquaplane, which would be useful for naval bombing and torpedoing, is very similar to the monoplane, except that the major wing slants downward instead of upward. The craft would be lighter than water, so that it would rise if the motor should fail. Increasing the speed and adjusting the rudder

would submerge the craft. Wheels would allow it to cruise along the bottom.

The motor power would be electric. Cruising vision would be furnished by a periscope. The pilot would be seated under a dome provided with hatch and sidelights. Oxygen cylinders would be used for a prolonged stay under water.

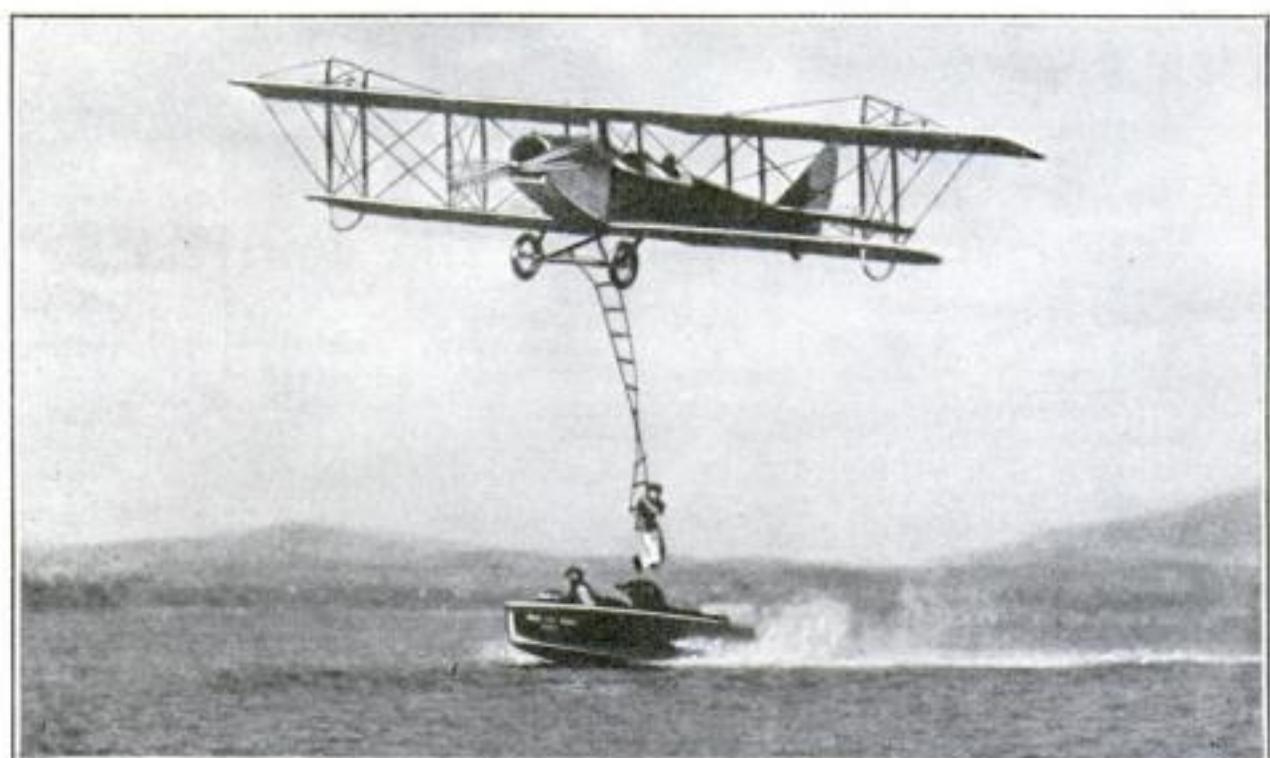
From Speedboat to Plane on Swinging Ladder

THE thrilling feat of transferring from a speeding motorboat to an airplane flying just above it was achieved at Coronado Beach, Calif., recently by Floyd Parsons, a daring stunt performer.

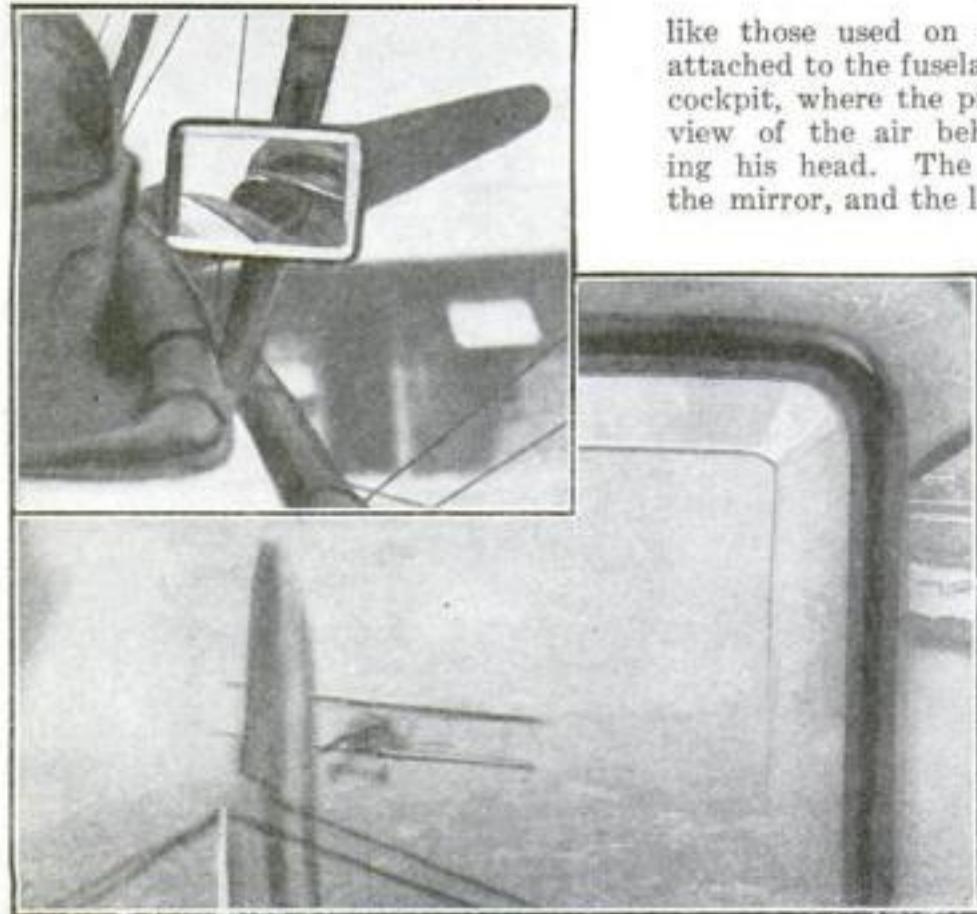
While the boat was speeding nearly a mile a minute the plane came up from behind, dangling a rope ladder from its under carriage. Parsons, poised on the stern of the boat, grabbed the ladder as it passed, and climbed to the plane as it rushed through the air.

Rear-Vision Mirrors for Safety in Flight

TO AVOID collisions in midair the U. S. navy is now equipping its planes with rear-sight mirrors very much



The daredevil, grasping a swinging ladder, climbs from speedboat to plane



The upper picture shows the rear-vision mirror in front of the pilot. Below: The pilot's view of an airplane behind him when this picture was taken

like those used on automobiles. It is attached to the fuselage at the side of the cockpit, where the pilot may get a clear view of the air behind without turning his head. The upper view shows the mirror, and the lower view what the mirror showed the pilot when this picture was taken.

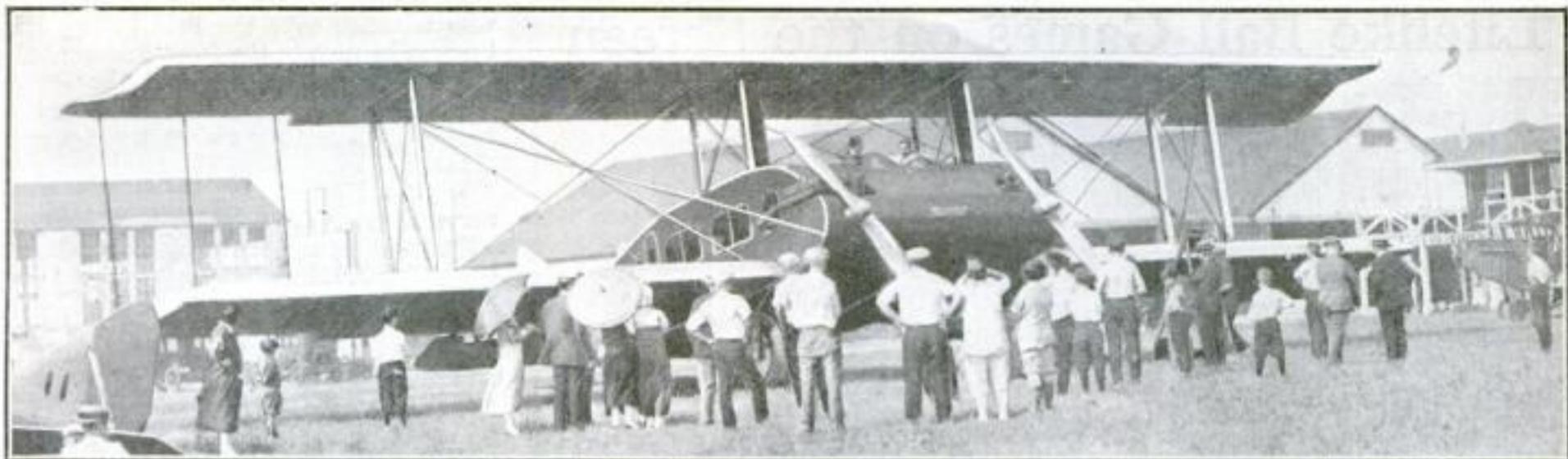
RADIO equipped seaplanes carrying observers are cooperating with a liquor-running fleet on Puget Sound, according to reports from Seattle, Wash. The planes, it is said, keep the members of the fleet informed of the approach of government speedboat rum chasers.

Dreadnought of the Air Launched in England

GREAT BRITAIN'S first dreadnought of the air, said to be the most powerful single-engined airplane in the world, recently made its first test flight from Brough airdrome. The huge plane measures 88 feet from wing tip to wing tip. It is 54 feet long and 19 feet high. It is driven by a 1000-horsepower Napier Cub engine. Although this power plant has 16 cylinders, it weighs only 2200 pounds. A locomotive developing the same horsepower weighs more than 147,000 pounds.

Some idea of the huge proportions of the machine may be obtained from the fact that its single propeller is more than 1½ times the size of a large billiard table. The tail alone is as large as an ordinary scouting plane. The plane is capable of carrying about three tons of bombs or torpedoes.

In spite of its great size, the test pilot of this great war monster declared the air leviathan was as easy to handle as a small, light plane.



This Mammoth Aerial Freighter Can Carry Two Automobiles

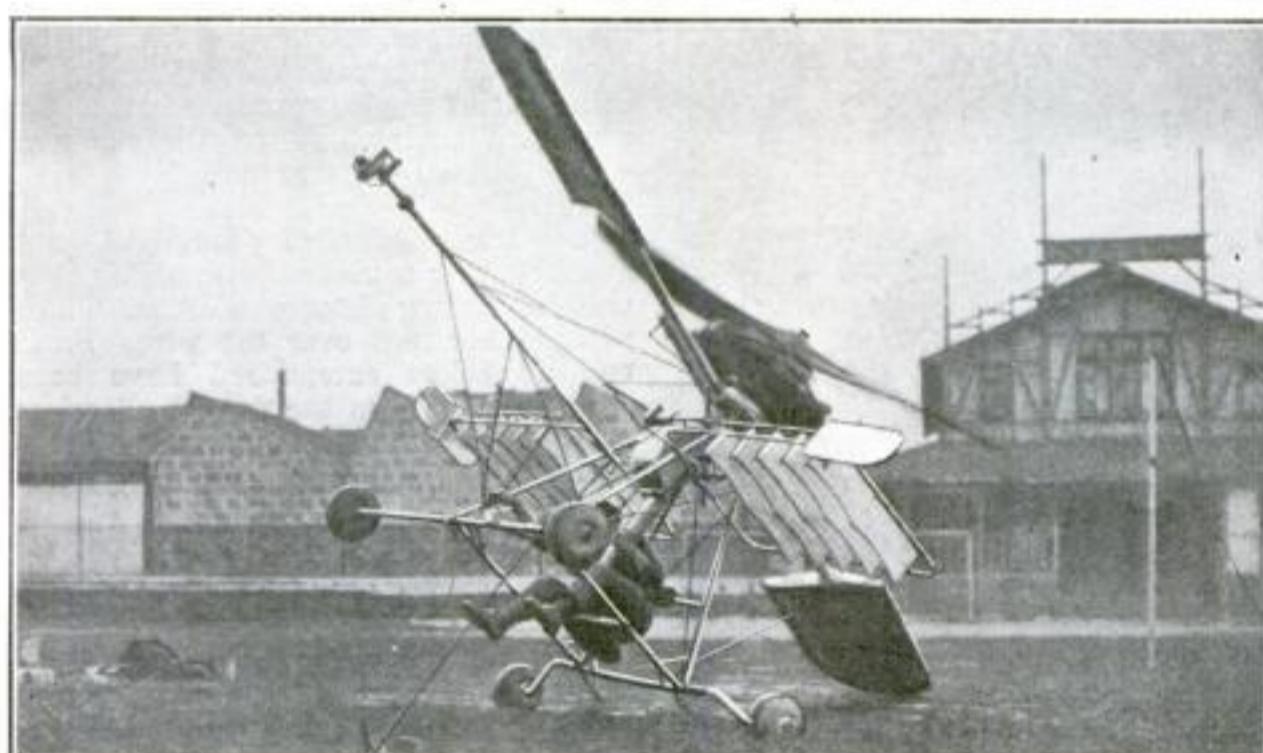
THE first aerial freight carrier ever built in the United States, in recent tests at Mitchel Field, L. I., rose with a full load to a height of 4200 feet in 10 minutes, and remained in the air for half an hour.

The machine is a Remington-Burnelli plane, carrying two Atlantic motors

especially imported from England. They are 550 horsepower each, and are said to be capable of driving the ship at a speed of from 100 to 110 miles an hour. The wing spread is 86 feet, almost equal to that of the Barling bomber, the largest army plane. The tires are 54 inches by 14 inches, the largest in use.

The weight of the plane unloaded is five tons, and six tons with fuel and pilot. It can carry three tons of freight, the equivalent of about 40 persons, and a crew of three.

Two automobiles can be transported if the bodies are demounted from the chassis.



A Helicopter Upset—He Forgot It Was Tied

AVIATION enthusiasts at Vache Noire, near Paris, got a thrill recently at the expense of the plucky pilot of a helicopter who forgot to untie his machine before trying to ascend.

The name of the aviator is M. Douhoret. He christened his queer vertical flight machine "Sandow." He stepped in, pushed the controls, started the motor, and quickly rose about three feet, when the anchor rope suddenly jerked him back to earth, causing the machine to turn over in an undignified forced landing.

The photograph above shows the machine at the instant it upset.

Interurban Air Service

AN ALL-METAL airplane with sound-proof cabins, fitted like a sleeping-car, with tables, reclining chairs, and other conveniences for eight passengers, has been making round trips between Chicago and Detroit during the last month or so. Before long, airplanes may be rivaling railroads and ships in the transportation of freight and passengers.

Baby Planes Meet in Long-Distance Race

GREAT interest was aroused by the recent Airplane Classic held in France especially for small machines. Some of the finest and smallest models of the entire country participated. The meet consisted of a race around France.

The top photograph shows Paul Carmier and his small airplane with which he was leading the field at the time he posed for the picture. The bottom view shows C. Ratabel and his tiny Bleriot plane.

FROM Boston to New York by airplane in 58 minutes was the remarkable record recently set by Lieut. R. C. Moffatt, U.S.A. He covered the round trip—a distance of 365 miles—in two hours, 12 minutes. By train the trip would take about 10 hours.

Automatic Air Pilots

MORE and more the human factor in the safe operation of heavier-than-air machines is giving place to automatic control. Remarkable progress in the control of pilotless planes by wireless was reported recently by the British Royal Aircraft Establishment, which also is experimenting with the launching of winged bombs from aircraft in flight and their control for a limited distance to the desired object.

In addition, a German scientist recently reported the perfection of a new steering device for planes, designed to make pilots independent of darkness, the invisibility of the earth and horizon, and other similar factors.

Rapidly the last remaining hazards of air transportation are being eliminated by science, as demonstrated by the success of coast-to-coast air-mail service.



Two of the tiny contestants in the around-Paris flight

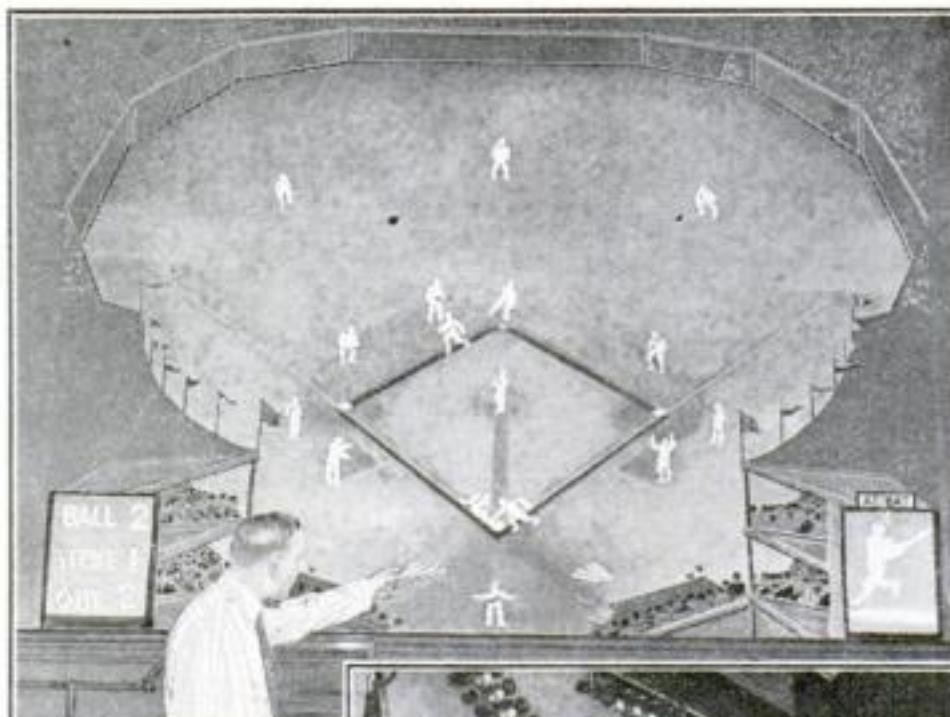
Lifelike Ball Games on the Screen

EVERY play of a baseball game is reproduced in moving figures on the screen by a new electric-light apparatus recently perfected by George S. Coleman of Washington, D. C. He claims it is the most complicated device of its kind ever built.

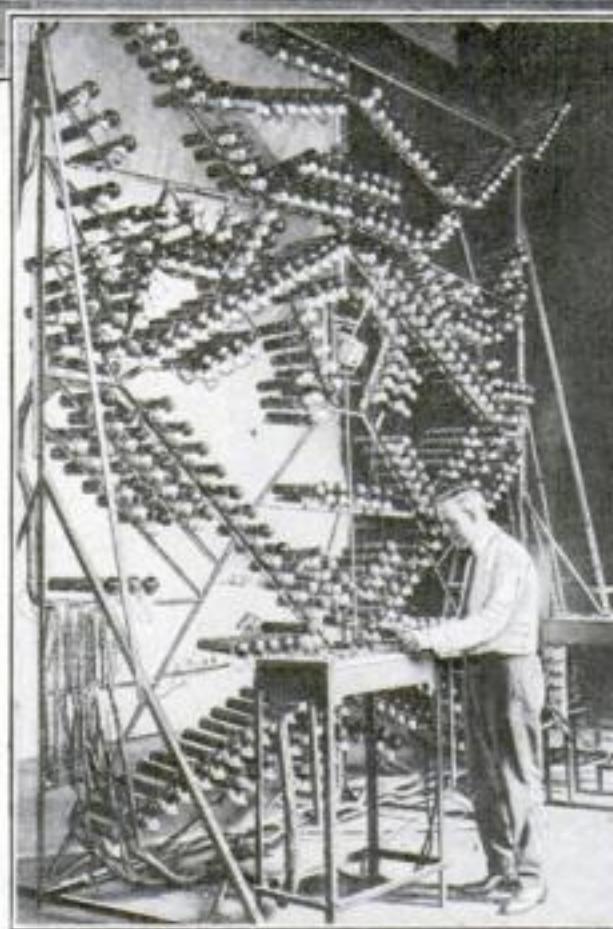
On the screen is a reproduction of a baseball diamond, with the players in their positions, and the grand stands crowded with spectators. Back of the screen is an intricate arrangement of electric lights.

As the plays are received by telegraph from the scene of the game, they are transferred into action over the light bulbs and thrown on the 30-foot screen. No announcements are necessary during a game because every incident in the game is shown, including umpire decisions, throwing the ball, hitting the ball, stealing bases, and sliding.

Construction of the apparatus required 10 years. Nineteen thousand feet of wire and 400 electric bulbs are used to show the players' movements.



Above is a screen portrayal of an exciting play in a ball game, produced with moving figures by the complicated apparatus shown at the right. This invention uses 400 electric-light bulbs.



Know Your Car

ONE of the important points of wear in your car that often goes unheeded, yet that, if neglected, may cause serious trouble, is the mechanism of the front wheels. Symptoms that give warning of trouble are wobbly wheels, hard steering, vibration, and excessive or uneven tire wear.

If the wheels are wobbly, the wheel bearings may be loose. To test for this, drive a wedge-shaped block between the end of the axle and the spindle so that the looseness in the latter will not be attributed to the bearings. If the bearings are badly worn, they should be replaced.

If the wheel is out of true, this may be measured by holding the end of a rule close to the side of the tire while the wheel is slowly turned. At points where the wheel is out of true, the tire will touch the rule.

If the rim has shifted on the felloe—where the spokes join the rim—they may be re-aligned by hammering on the rim with hammer and block of wood.

If the wheels are too far apart at the bottom when the wheels themselves are true, the axle may be sprung or the steering knuckles bent. Either defect will cause extreme wear to the tires.

How Forests Are Planted

IN THE Adirondack Mountains, N. Y., are areas where trees must be transplanted from nursery beds because scattered seed will not grow. The work of reforestation is done by large crews of planters employed by the government,



Planting seedlings, one line of men dig the holes; another line does the planting

who advance over the field in two long lines. The men in the front line dig holes for the seedlings. Those in the second line follow, carrying the seedlings in buckets, where they are kept moist until planted.

In the United States are 81,000,000 acres of land that cannot grow trees without being restocked by man. So far, only 1,500,000 acres have been replanted.

Pictures Sent Over Wires in Eight Colors

A FEW months ago considerable interest was aroused in the scientific world when engineers of the American Telephone & Telegraph Company and the Western Electric Company demonstrated a speedy, commercially practical method of transmitting pictures by wire. Now, by the same process, pictures in eight colors are transmitted and reproduced with entire fidelity, within an hour.

This remarkable use of the transmitting mechanism was suggested by Stephen Horgan, of New York, a pioneer in periodical illustration and the inventor of a method of picture transmission that was used successfully on the Atlantic cable between London and New York in 1879.

The transmission of colored pictures is effected by a method resembling that used in printing pictures in colors. Three pictures are sent over the wire. From one all colors except red have been screened out; from the second all colors except blue; from the third all colors except yellow. The pictures are transmitted and received in black and white by the usual process. Then, when received, the original colors are restored, and the result is a picture that contains not only the three primary colors transmitted, but five other intermediate tones, just as in color printing one color plate is superimposed on the printing of the other color plate.

The transmission of colored pictures was undertaken merely as a laboratory experiment, but the engineers who developed the process say that it is fraught with practical possibilities such as the identification of criminals, or stolen property, as jewels and paintings.

Alchemist Makes Gold from Quicksilver

THE manufacture of a dollar's worth of gold from mercury has been achieved by a modern alchemist, Professor Miethe of the Berlin Technical School, according to recent reports from Germany.

In the light of modern scientific knowledge about the structure of matter, scientists are practically agreed that such cannot be called impossible. Yet they point out that the experiment can hardly be said to have immediate economic value; for that dollar's worth of gold was produced at a cost of \$60,000, or at the rate of more than \$2,000,000 a pound!

The process is reported to consist of subjecting the quicksilver to tremendous heat in an electric furnace. It is said to have been discovered during an experiment in which a mirror, backed with quicksilver, was exposed accidentally for a long time to a very hot flame. Specks appearing on the mirror suggested the change to gold.

The experiment apparently was based on the theory of modern science that the difference between various substances is due to differences in the arrangement of the electrons composing their atoms, and that the application of exceedingly high temperature to a given substance, such as gold, would dislodge one or more electrons from each atom, producing an entirely different substance.

If quicksilver could be transformed cheaply into gold, it undoubtedly would revolutionize the world's currency, for at present prices quicksilver is worth less than a dollar a pound, while gold is worth about \$330 a pound.

A New Kind of Bread Made with Cocoa

IN UNCLE SAM'S bakeshop in the Department of Agriculture's Bureau of Chemistry, experimenters recently developed a new cocoa bread that soon may find a place on your dinner-table. The bread has a decided flavor of cocoa, and is said to

keep fresh longer than ordinary bread. The recipe consists of substituting cocoa for from eight to 10 per cent of the flour in any good bread formula, and omitting shortening, which is supplied by the cocoa. Sugar and cocoa in equal amounts are used, making the baked loaf dark brown in color.



L. H. Bailey, in the bakeshop of the Bureau of Chemistry, mixing cocoa bread, in which cocoa is substituted for eight to 10 per cent of the flour



Professor Miethe, of the Berlin Technical School in Germany, who recently announced he had succeeded in producing a dollar's worth of gold from mercury, thus realizing the alchemists' dream of the centuries. The experiment cost \$60,000

The experimenters believe their new product will become increasingly popular in American households, and that it will be found pleasing to most tastes.



Rev. Francis A. Tondorf, S. J., noted seismologist, with the new earthquake-recorder

New Instrument to Detect Quakes

GREATERT accuracy than ever before in detecting and recording earthquake shocks is claimed for a new seismograph recently completed at Georgetown University, Washington, D. C.

The instrument was constructed under the direction of the Rev. Francis A. Tondorf, S. J., one of the world's foremost seismologists, and it is declared to be the finest instrument of its kind in North America. It is known as a Galitzin vertical seismograph.

How Much Do You Know about Science?

The twelve questions printed below were selected from hundreds of questions asked by our readers. How many of them can you answer correctly?

Here's a chance to test your knowledge of fundamental facts of science. Answer the questions as best you can, then turn to page 165 and see how nearly you were right.

1. Why is salt needed in food?
2. How do we know that the earth is slowly shrinking?
3. Is electricity a form of matter?
4. How were the Pyramids built?
5. Can you make boiling water any hotter by turning on more gas?
6. How do we know what the stars are made of?
7. If fire burns oxygen, why does not the air catch fire?
8. How do muscles exert power?
9. What is the difference between positive and negative electricity?
10. Is a stone alive?
11. How are messages carried along the nerve fibers?
12. Why do people wear jewelry?

Man Beats Horse in Six-Day Race

IN A recent six-day running race between a horse and a man at the Crystal Palace, London, England, the man won a decisive victory.

The human contestant was C. W. Hart, famous long-



distance runner, now 59 years old. The horse was "Haucy Lassy," ridden by Jockey Arthur Nightingale.

The race revealed the surprising fact that a trained runner has greater endurance than a horse. Both horse and man ran for 10 hours each day. At the end of the fifth day, the horse was withdrawn. Hart won by eight miles. The total distances run were: Hart, 345 miles; horse, 337 miles.

Brush and Comb Combined in New Patent

WHAT is said to be the first and only existing patent on hair combs has been issued for a combination brush and comb in one.

Brushing bristles protrude laterally from holes in the sides of the teeth of the comb so that a stroke combines the action of both comb and brush. The teeth are set farther apart on one half of the comb than they are on the other, so that the coarseness and fineness of the usual comb are retained.



Combing and brushing in one operation

The horse and man hitting their strides in the six-day endurance race, which was won by the man

Is "Eat and Run" Habit Making Us Small?

WILL the modern quick-lunch counter and the "eat and run" habit make America a nation of diminutive people?

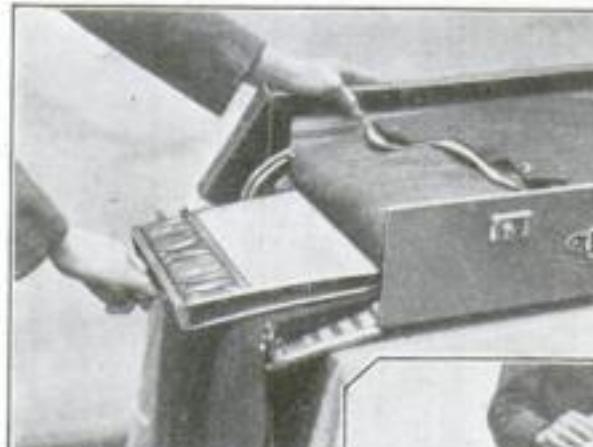
Doctor John Harvey Kellogg, dietist and superintendent of the Battle Creek Sanitarium, Battle Creek, Mich., is one who believes so. Doctor Kellogg says:

"The stature of the American people has dropped two inches in the last 60 years, due to the modern American custom of bolting food as pythons do."

"The American public give little or no thought to the proper consumption of food. Our modern business activities are so hurried and intense as to allow no consideration for the most important element of healthful living—the proper selection and careful mastication of food consumed."

"A height in stature of over six feet prevailed in the early sixties; today the average normal height of the American people is much below six feet, a condition attributable to our modern quick-lunch counters and hurried mode of living."

Trousers Kept Pressed in Handy Suitcase



Four pairs of trousers, held between stiff fiber plates, are kept creased in the new pressing-case, as shown above. The photograph at the right shows the case open and a pair of trousers being withdrawn from the stiff fiber pressing plates



TROUSERS are freed of wrinkles and kept creased, it is claimed, if they are left in this pressing-case. It is shaped like a suitcase and has two hinged ends for convenient removal of the clothes. Stiff fiber plates with metal cross strips and thumb-screws apply pressure to the trousers.

Four pairs of trousers can be carried in the case at one time. The plates that hold them slide in and out of the case like drawers, so that it is easy to get at any one of the pairs of trousers without disturbing the others.

Each of the sets of pressing plates is fitted with a handle to facilitate moving them in and out.

Typist's Copy-Holder Has Magnifying Glass

A COMBINED copy-holder, sight reader and spacer for the typewriter is the invention of George C. Hohein, of Clarendon, Va. Depressing the spacing bar shifts the copy-board, bringing a new line into view before the operator.

A magnifying glass suspended in front of the machine permits the operator to watch her notes without straining her eyes. The device also allows the stenographer to sit in a natural position with the copy directly before her rather than down at one side.

Airplane Made of Paper

NAVY experts recently began a series of tests with a new kind of airplane, the fuselage of which is of paper composition. If the tests prove successful, other similar planes will be ordered.



The copy-holder and magnifying glass attached to an ordinary typewriter

Are You Growing Deaf and Don't Know It?

Try these easy tests on yourself—Important facts you should know about your ears and how to care for them

The writer of this article is one of the foremost ear specialists in America. He has been associated intimately with the American Federation of Organizations for the Hard of Hearing, the work of which is largely along the lines of preventing deafness and rehabilitating the deaf mentally, socially, and economically.—The Editor.

I WAS on the porch of my lakeside home when a girl and man passed me in a rowboat. The girl was doing the talking.

"That poor girl is deaf," I said to my wife.

"How could you tell that at such a distance?" she inquired.

"That's easy. Her voice is pitched too high and she is talking about two degrees louder than she should."

"How sad!" she remarked.

"Yes, it is sad," I replied emphatically. "That young girl knows she can't hear well, but she is trying to hide the fact. She doesn't realize that if she neglects those ears of hers, she probably will become hopelessly deaf in a few years. The worst of it is that she might have prevented this trouble—at least her parents might have helped her prevent it—if they had begun treatment at the proper time."

No doubt, like my wife, you sympathize with the girl in the rowboat; but what about your own ears? Are you certain that you, too, may not be headed for the tragedy of deafness? Did you ever try to find out just how well you can hear?

DID you know that if you would test your ears occasionally you might save yourself untold trouble and misery later on?

You have a watch. There are human voices around you. These are sufficient for simple ear tests. In addition, you can go to a competent aurist, if you are not sure your ears are all right, and have them tested with tuning forks and other scientific paraphernalia. The trouble is that most people are indifferent until it is too late.

Suppose we look at some startling figures:

It has been ascertained that one out of every 10 persons in the world has a defect in hearing in one or both ears!

More than 100,000 persons in New York City alone are suffering from defects in hearing sufficient to handicap them either socially or economically! And conditions in New York are typical of those in other of our large cities.



A simple way to test your ears is with an ordinary watch. If you cannot hear the watch tick six feet away, the chances are your hearing is defective

If you are not hard of hearing, it will be difficult, perhaps, for you to appreciate the tremendous obstacles that confront those unfortunates who are. But listen to this one experience:

A young woman walked into the rooms of the New York League for the Hard of Hearing the other day to ask advice and to seek aid in finding a job. She had been a stenographer. Gradually she had noticed that it was becoming increasingly difficult for her to understand dictation. Singing noises in her ears had given her the "jumps," and often had kept her awake at nights.

Tears ran down her cheeks as she told her story. An attack of measles in childhood had affected both ears, but when she recovered and returned to school she didn't realize that her hearing was different from that of the other children.

Sometimes when the teacher placed her far back in the room, she couldn't hear what the teacher said, but no one seemed to think anything of that. When she was eighteen years of age, she went to work as a stenographer. She was now twenty-four.

"I don't want any one to know I am deaf," she sobbed hysterically. "I am so ashamed. I don't know what I can do. No one seems to want me."

"I don't want any one to know I am deaf!" There lies the trouble in placing such persons in the right jobs, and

in obtaining accurate statistics; but more important and more tragic is the fact this statement implies that a deaf person is outside the realm of conversational enjoyment. He lives within a warped shell. He carries a chip on his shoulder and feels that the whole world is against him.

He is fearful that he will not understand and therefore, often, does not try to understand.

WOULD you rather be blind than hopelessly deaf? Most persons would answer at once that they would rather be deaf. Ask Helen Keller or other blind deaf mutes. All will tell you that deafness is far worse, chiefly because conversation supplies word pictures that are easy to understand. And if you can't get word pictures you may as well quit the job of worthwhile living.

Did you ever notice that the blind person is almost always cheerful and optimistic? Did you ever notice that the deaf person is almost always morose and pessimistic? A blind person and a deaf person were in the same gathering on one occasion when this observation was propounded.

"That's easy to answer," said the deaf man. "When you talk to a blind man, you make him forget his troubles. When you talk to a deaf man, you are constantly reminding him of them."

There is the difference in a nutshell. If you don't believe it, put radio phones over your ears and try to hear the conversation about you while you are tuning in on a station. You'll be able to hear hardly a thing. Or else stuff your ears full of cotton for one day and try to enjoy yourself. By nighttime you will find that you are tired and nervous. Imagine how you would feel if that was

your condition for 365 days in the year! Acute hearing is so commonplace that the majority of people appreciate it only when they have lost it. It is more than worth while to know how well you hear. But it is even more important to find out how well your children hear, for most of the deafness which is so apparent in later life, comes on insidiously in childhood. Contagious diseases are the most important causes, but other factors are neglected colds in the head, often due to faulty hygiene of the nose and throat, which can be remedied readily.

MEASLES is responsible for deafness more than any other disease. Next in line comes scarlet fever. It should be the universal custom every six months to test the hearing of every child who has had any ear trouble during a contagious disease, because it is at this early age that simple treatment will give the best results.

During the past two years, of more than 200 children examined by a competent New York specialist and his associates, nearly 50 per cent had running ears. Another 40 per cent had "stuffy" ears, due to catarrhal conditions of the nose and throat which blocked up the little tubes leading from the throat into the ears. The other 19 per cent had blown their ear drums loose by holding the nose too tightly while blowing it.

The pocket-handkerchief often is responsible for deafness, because many a person, blowing his nose, makes trumpets of his ears. Children especially should be instructed how to blow the nose properly. Only one side of the nose should be held at a time, or the handkerchief should be held loosely below the nose.

ANOTHER frequent cause of deafness is the accumulation of cerumen (wax) in the ears.

This matter of keeping the ears clean and the wax under control is important. A very small percentage of cases of chronic deafness is due to wax, but very often a person becomes suddenly deaf because the wax presses upon the ear drum, or because some water has entered the ear and has caused the wax to swell.

If you have been hearing well, and suddenly for no apparent reason, your hearing fails, you may determine whether wax is causing the trouble by filling the ear canal with undiluted peroxide of hydrogen and allowing it to bubble in the ear for about five minutes. The peroxide will soften up the wax and relieve the pressure upon the drum. But your ears never will be normal again until the wax has been thoroughly washed out with a bicarbonate of soda solution.

How often have you heard a person say that his deafness started from an ear inflammation, due to swimming? "I couldn't get the water out of my ear" he tells you.

There is no doubt that swimming and

bathing do cause ear trouble, but all the ear plugs in the world won't relieve this condition; for the cause of most of the trouble is not the water that gets into the ear from the outside, but the water that is blown into the inside of the ear. If the water has swelled up the wax in the canal, the trouble is seldom serious if you apply the remedies I have mentioned. But if water has entered the middle ear, an infection soon may develop which will result in a middle-ear abscess or even acute mastoiditis—an infection of the cells in the bony prominence behind the ear.

Many infections in the middle ear

see how intricate the ear is and how close it is to vital structures, you would pay more attention to the troubles that often are neglected until it is too late. Sound reaches the drum by waves that travel through the ear canal. Behind the drum is a chain of small bones—called "the hammer, the anvil, and the stirrup"—which are set in motion by the sound waves until a foot plate of the stirrup is set in motion and irritates the fluid in the internal ear. This sends impulses through the ear (auditory) nerve to the brain, where they are translated.

THREE is a distinct difference between noise and sound. Every vibration of the air produces a noise, but only when this noise is properly interpreted by the brain does it become sound. The wonder is how many noises we are able to eliminate from our consciousness. For example, if a person is walking along a street where many trucks are rumbling by and a street car is going past at full speed, such noises do

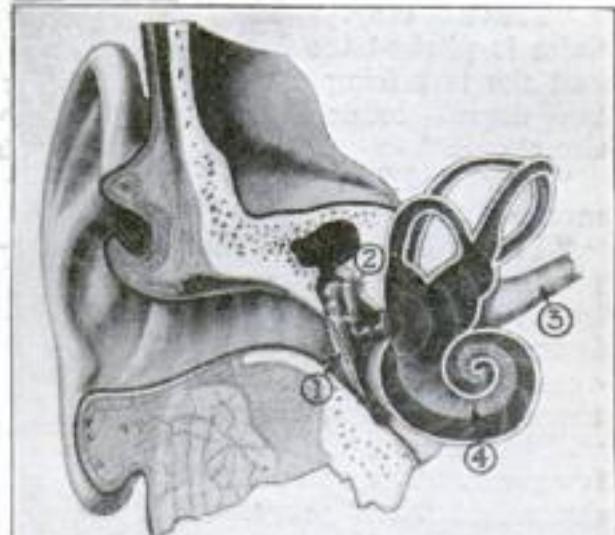


This newly perfected amplifying machine, recently installed in the Cook County Hospital, Chicago, is designed not only to aid the partially deaf to hear, but to test the ears of patients. The photograph shows an experiment in which sounds from a phonograph are amplified and carried to the patient's ears

formerly were caused by impure water in swimming pools. This fact is so well recognized to-day that most of the municipalities see that the water is sterilized by ultra-violet rays. There is another danger to swimmers, however, that is just now being recognized. It has been found that the body temperature of most swimmers who stay in their wet bathing suits too long is lowered at least one degree. They leave the hot atmosphere of the pool or the hot beach with wet hair and undried bodies, then ride long distances in open trolley cars or open automobiles. Their resistance is so lowered that they are susceptible to pneumonia and ear infections which may result in irreparable harm.

NATURE has her own ways of warning us that troubles are brewing and it is up to us to pay attention to them. It often happens that a person loses nine-tenths of his hearing without knowing it; then there develops a little singing noise, or a buzzing, a throbbing, inside the head. As soon as this symptom occurs, the patient should have his hearing tested. The trouble may be due to a misplacement of the little bones in the middle ear, or to changes in the arteries in the internal ear. It never will be remedied until the cause is found and eliminated.

If you could look inside your head and



The wonderful mechanism of the human ear, showing how we hear sounds from a head phone. Sound waves produced by the vibrating diaphragm of the phone travel through the ear canal and are first received by the eardrum (1), where they set up corresponding vibrations. Behind the drum is a chain of three small bones known as the hammer, the anvil, and the stirrup (2). These are set in motion, and transmit the impulses to the internal ear (4). From there the impulses are carried through the auditory nerve (3) to the brain, which translates them into sound

not bother him, if he is city bred. They are not interpreted by his consciousness and he is able to hear your conversation as well as in a quiet room.

The most acute hearing is possessed by the savage who roams the woods and relies upon his ears as well as his eyes to stalk his prey. The poorest hearing is found among the highly civilized.

Many a person discovers he is deaf in one ear from the fact that when he lies in bed at night with the good ear against the pillow, he is deaf as a post to the ordinary noises around him. But does such a person ever inquire whether the hearing in the "good" ear is up to the mark?

(Continued on page 164)

The Housewife's Laboratory

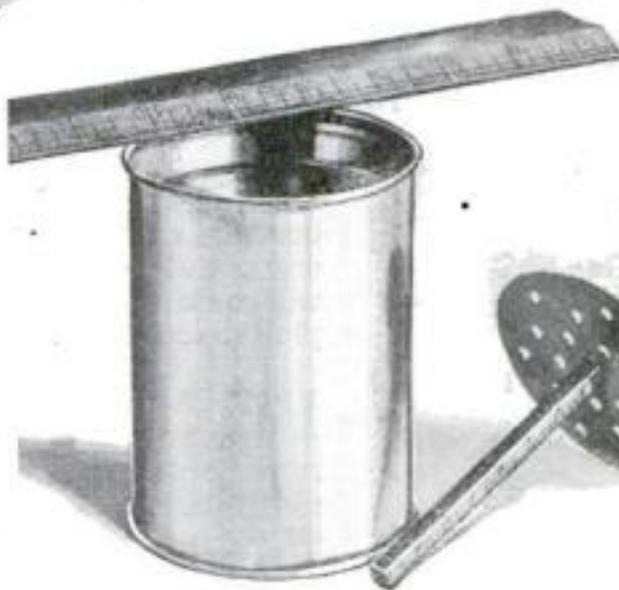


A new invention for the nursery is this portable bath and dressing - room for the baby. In addition to a small tub, the wagon holds drawers and a cupboard

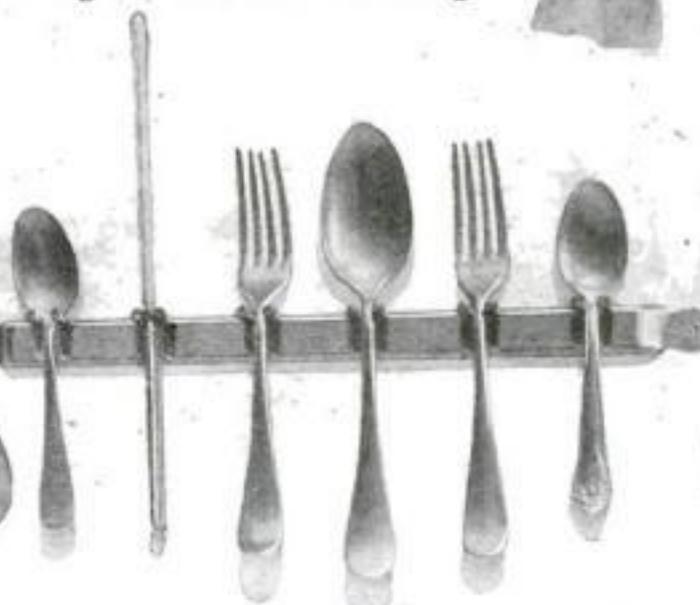


By the use of these four large aluminum pins, the Thanksgiving turkey can be laced easily. Removing the pins frees the string

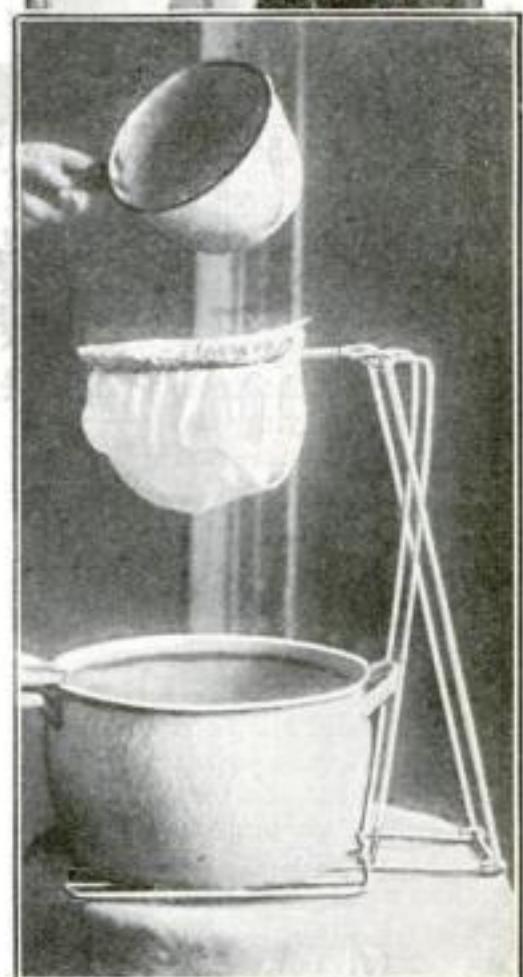
A new portable electrical wringer is quickly detachable from its stand and can be used almost anywhere. It is equipped with an automatic safety device, and has no exposed gears



A ruled bar with a perforated disk at one end serves as a gage to determine whether canned goods contain more liquid than necessary. As the liquid filters through, the disk sinks to the solid portion of the contents



A handy rack for keeping kitchen utensils within easy reach consists of a metal wall bar with prongs in which knives, forks, and spoons can be hung, as illustrated



This convenient jelly strainer is supported firmly by a folding stand, with a wire base for holding a preserving pan



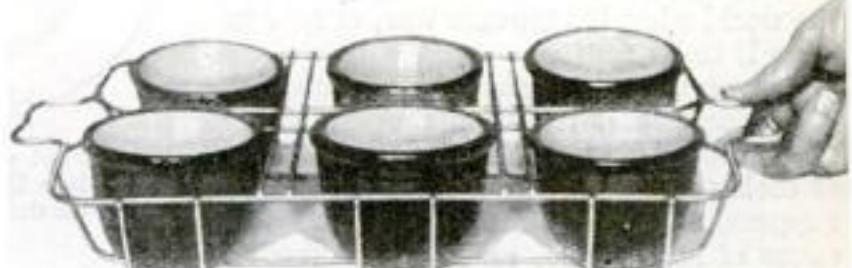
A folding ironing-board that can be packed in a suitcase is a new convenience for the woman traveler. The board, hinged at the center, is padded and covered with a removable, washable cloth



Fruit or vegetables are washed conveniently in this sanitary aluminum colander, which distributes the water over the contents



When the handles of this grapefruit corer are pressed together, two jaws bite out the core



By the use of this wire frame, several custard cups may be removed quickly from the oven in one operation. The device prevents danger of burned hands, tipping of the cups and the consequent spilling

When Your Motor Calls for Help

How to Diagnose Auto Troubles from Noises You Hear

By E. B. Staples

DRIVING along a country road not long ago, I came upon a stalled car. In front of it, sweating, fuming, and as dirty as a coalheaver, was a nice-looking young fellow in a light gray suit. I remember that gray suit particularly, because, though it was new, it was smeared with dirt and grease beyond the power of any cleaner to remedy.

Strewn around the car were tools—everything from a jack to a screwdriver. Though you could see very well that he was near exhaustion, the young man was spinning the motor with the hand crank—round and round and round. But the motor wouldn't start.

When he heard me coming, he stopped his cranking and ran out into the road to hail me.

"Say, give me a pull, won't you?" he asked. "I've been stuck here for half an hour and can't get started. The self-starter doesn't do it; neither does the hand crank. Maybe if you can start me rolling, I can get going."

I steered my car around in front of his, hitched on my tow-rope—for all the tools he was carrying he didn't have one—and off we started. After going a few rods, I stopped and looked around. Still no sound from his motor. Right then I got an inspiration.

"Have you got any gas?" I shouted.

HE STARTED to say something, but I didn't wait to hear it. I ran to the back of his car and examined the tank. It was absolutely empty!

Now, don't laugh at this fellow, who'd spoiled a pleasant trip and a good suit of clothes because he'd forgotten to fill up his gas tank. Take an old-timer's word for it, he was typical of many drivers—not so much because he had neglected to buy gas, but because, when he got into trouble on the road, despite forewarnings from his motor which he should have heeded, he hadn't the slightest notion in the world what his trouble was, or how to trace it to its source.

For even after I gave him some gas, he couldn't start the car! Before I came up, he had been using his large collection of tools to tinker with the car, hoping, I suppose, that he'd stumble across the cause of his trouble, and he'd succeeded in changing so many adjustments that the car wouldn't run. When he had pointed out what nuts and cocks he had turned, it took a half-hour before I could start the car.

Now, to me that young fellow's ex-

perience was a whole sermon for motorists. Even aside from his carelessness in starting on a trip without filling his gas tank, he'd done so many things that were wrong that he deserved, I'd say, to have his car taken away from him. In the first place, he'd started to "fix" his car without knowing what was the matter with it, or what to do with it.

I can't imagine anything worse than that, unless, perhaps, it's taking a lot of medicines that you don't know anything about in the hope that one of them will cure your illness.

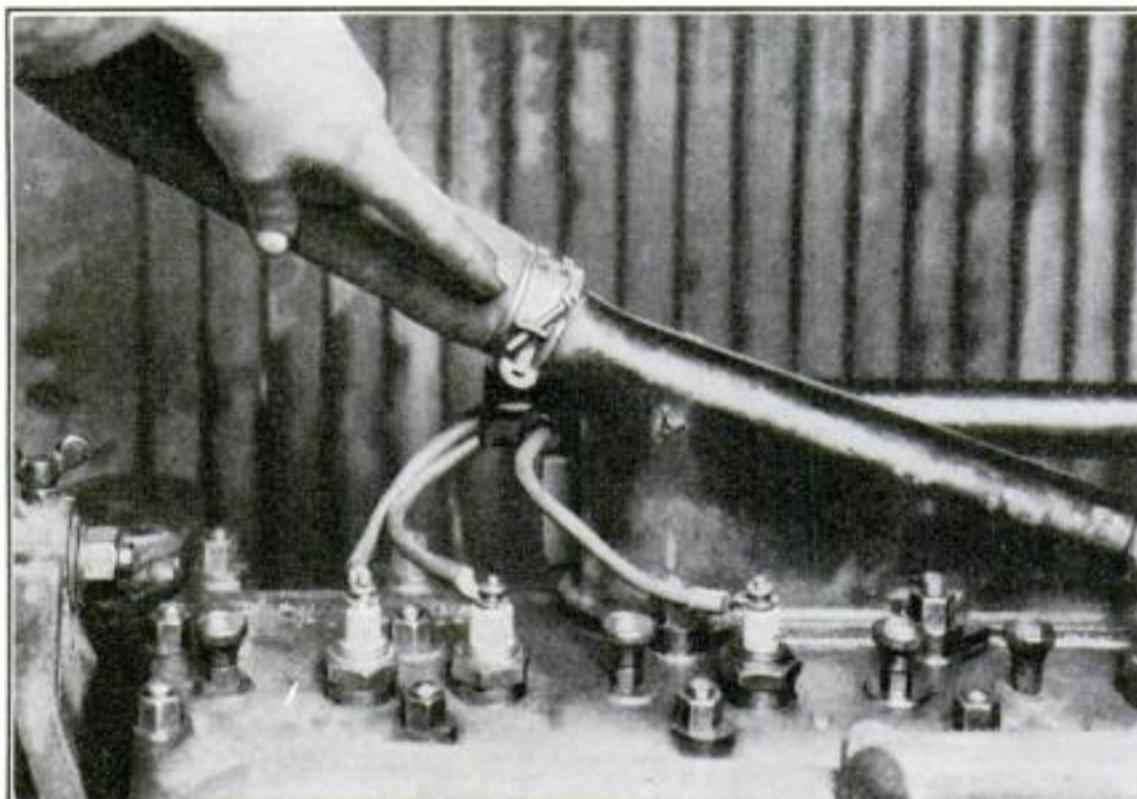
overalls, an old raincoat, or some other covering to save your clothes in case of trouble. And, when you're buying equipment, don't forget a tow-rope!

Now, I've said that coming troubles announce their approach by characteristic warnings. About the most frequent of these is a missing motor. When your cylinders miss fire, get out and start an investigation! Test your battery to see if it is running down. Go over the ignition wires, looking for a possible short circuit or else a loose connection. Examine the distributor to see that it is clean, dry, and making good contacts. Take out your spark plugs and examine them for cracked porcelain or improper spark gaps. If the plug is covered with carbon, it is not a disease, but a symptom. The real trouble is deeper. It may be poor oil, poor compression, weak spark, too much oil, improper carburetor adjustment—any one of these things will cause a good spark plug to foul.

IF THE trouble is in your fuel line—gas running out, gas line clogged, carburetor empty and so on—your motor will usually spit or cough before dying. In this case,

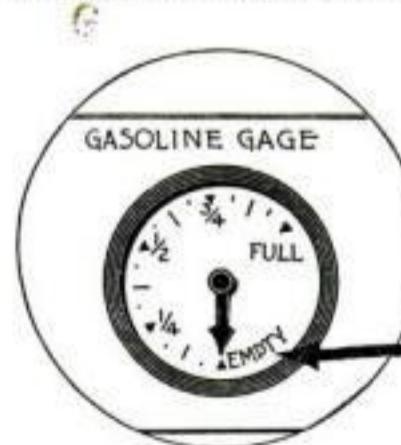
the first place to look is in the gas tank. If that is full, see if there is gas in the carburetor. See that the sieve or strainer in your vacuum tank is not clogged with sediment. Then test your spark by holding a piece of wire about a sixteenth of an inch from a clean metal part of the motor.

Nine times out of ten, these tests will

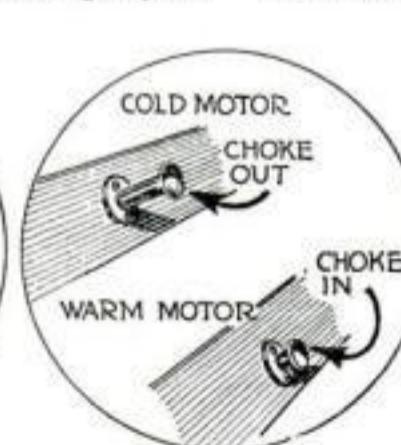


When your motor heats up too rapidly, or overheats, look for a loose radiator hose connection. It is well to inspect hose clamps frequently to make certain that they are tight

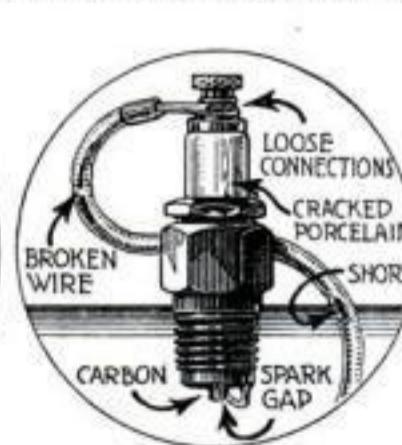
If you drive an automobile, here's a rule to paste up in front of the steering-wheel where you can always see it, and where it will be a reminder: "Never fix anything until you're sure it needs fixing!" The thing to do is to learn about your car and its action so well that you'll always know beforehand from unmistakable noises and other signs just



First rule of motoring: Before starting, see that you have gas



To avoid trouble in starting, learn proper adjustment of choke



If your engine misses, examine spark plugs for above defects

what is the matter when the car stops suddenly or develops other kinds of trouble. Also, while I still have that young man in mind, don't, as he did, start off on a trip in a new suit without

suffice to put you on the trail of your trouble.

Sometimes, though, warnings are not very clear, and require considerable study before they can be interpreted.

Once, for example, I was driving a car the motor of which would get attacks of choking and smothering, as if the carburetor were flooded or the choke closed. Investigation showed these all right, so it occurred to me that it was possible that the motor was taking gas through the suction line to the vacuum tank. I made no changes, though, until the gas ran out and the engine stopped. Then, examining the vacuum tank, I found that the valve that closed the suction line when the tank was full had become disconnected. As in most cases of motor trouble, making repairs in this case was a comparatively easy matter after the real cause of the trouble had been found.

WHEN your motor heats up too rapidly, or overheats, you are receiving a sure signal of some kind of trouble. The cause may be a late spark—in which case look to your timer and see whether it has slipped—or it may be a loose fan belt, clogged radiator, improper adjustment of the carburetor, or carbon in the cylinders. Frequently, too, it may be that you are losing water from your radiator through a loose hose connection. Many a careless motorist has had trouble because he neglected to keep his clamp tight. At all events, whatever the cause, don't attempt to drive your car while the motor is boiling, or you may do irreparable harm. However, provided that the fan is running, water is circulating, and you have plenty of oil, you will be able to cool an overheated motor more quickly by permitting it to idle than by stopping it altogether.

If your motor is firing on all cylinders, and still shows a loss of power, see if the loss is not due to poor compression. Worn piston rings, an improper amount of oil, or a "late" spark may be the cause. Or it may be a clogged muffler.

is running, and watch for air bubbles.

Carbon, an overheated engine or a spark that is advanced too far sometimes will cause an engine to knock in a way that suggests a loose main bearing. A loose bearing, however, is more likely to make its presence known by a knock when the motor is first started and before the oil has begun to circulate.

Sometimes a motor will lose power and begin to miss near the top of a hill or after having been driven through mud, sand, or some other kind of "hard going." Usually the cause will be a clogged screen in the fuel-line connection at the carburetor.

I have known water to lodge itself in this screen and freeze, thus stopping the flow of gas. Sometimes the flow of gas at this point will be stopped by the expansion of the gasoline in the pipe and

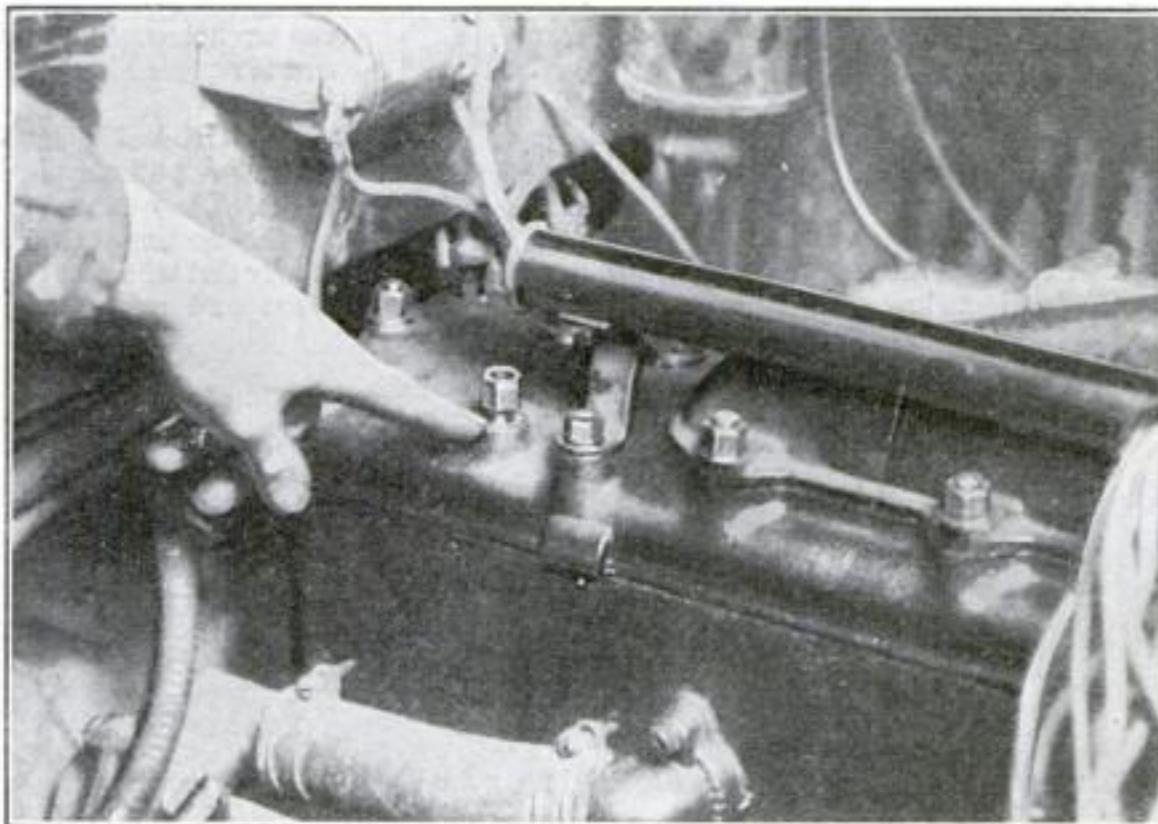
never choke a hot motor, however. More than one motorist has frantically telephoned to a garage for assistance in starting his car when his only trouble was that he was attempting to start a hot motor with the choke fully closed.

If your motor pumps oil, the trouble, nine times out of ten, is that you have filled your crankcase too full. Too high oil pressure, loose pistons, worn rings, scored cylinders, or use of a too light grade of oil also will cause oil pumping. If your motor, oil connections, or other parts of your car permit oil to leak, remedy the cause immediately. Losing oil by leakage is not only wasteful, but dangerous, for it may reduce the oil level to such a low point that a few miles' drive will ruin the motor.

Be on the lookout, too, for the slightest trouble warnings from your steering gear, for these may save your life. If you notice any peculiar action in steering, stop at once and look for a flat tire, then for a disconnected tie-rod. It is possible for a tie-rod to become disconnected and for the trouble to remain unnoticed even in miles of driving. If the necessity arises to make a sudden, sharp turn, however, when a tie-rod is uncoupled, the results are almost certain to be disastrous.

I have purposely confined this article to a discussion of the commonest motor troubles—those that the average driver can detect and repair himself, especially those that are likely to be noted on the road when the driver is far away

from expert assistance. Study your car so that if any of the things I have mentioned happen to you, you can go "trouble shooting" with a fair chance of tracing your trouble to its source and repairing it. Don't, though, like the young man I told about at the beginning of this article, start any haphazard "fixing." It will only add trouble.



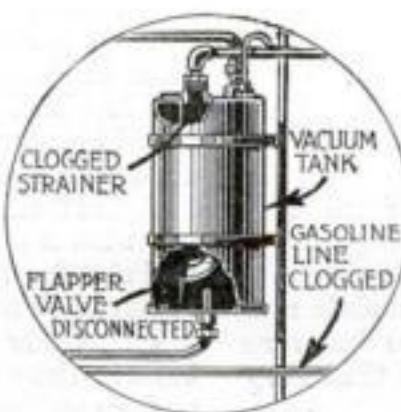
If lack of power causes you to suspect loss of compression, examine the nuts in the cylinder head. These often become loosened along very rough roads, but often are overlooked

carburetor, due to heat. This usually will occur during the summer, while the motor is idling after having been heated up. Another cause of lack of compression is loose nuts in the cylinder head. Failure to tighten these nuts is a common error of amateur repairmen and one that is very easily prevented.

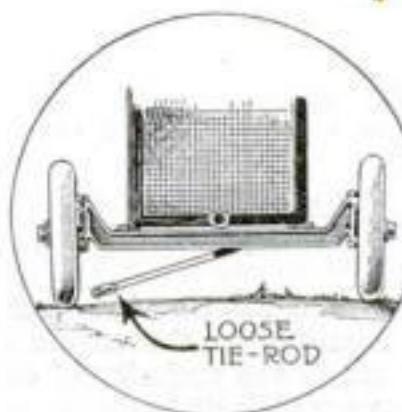
Operating the carburetor choke may



When motor overheats, the trouble may be a loose fan belt



This diagram explains common troubles in fuel line



If you notice peculiar steering action, look for loose tie-rod

Sometimes there are compression leaks around spark-plug openings and other joints. An excellent way to search for these is to squirt a little gasoline against the joints with an oilcan while the engine

seem a most simple matter, yet many motorists do it improperly. When your motor is very cold, you need a full choke to start. Then open the choke gradually as the motor warms up. You should

Danger to the Motorist Using Green Visor

THE use of a protecting green visor over the windshield of a closed car increases the hazard of driving, according to F. F. Barr, member of a large optical concern at Rochester, N. Y. He points out that under certain circumstances the shield may prevent a driver from seeing a red signal ahead.

Red and green traffic lights in the cities, he says, usually are mounted at about the height of the first story of a building. To see them the driver must look upward at a considerable angle. If the car is equipped with a green visor, he must observe the signal through this visor; and since green is complementary to red, he will be unable to see the red signal.

Auto Kinks that Save Labor

Improved Methods

THREE useful additions to the Ford motor are shown in Fig. 1. At A is a 24-candle-power light attached to the dash with a double-end headlight socket. This is a great convenience for working around the motor at night. The same socket also can be used for attaching a lead light for use around the car.

At B is a pocket for pliers. This consists of a piece of leather tacked to the dash. It is a handy place to keep the always useful pliers and saves a lot of time looking for them when they are needed in a hurry.

A primer cup attached to the intake manifold appears at C. This serves two purposes—it may be used to prime the engine in cold weather and also serves as an auxiliary air valve. Leaving the valve open after the motor is warmed up will increase the speed from 10 to 15 per cent. The valve is provided with a rod running through the dash for adjustment from the seat.

REFILLING the pressure type of grease gun, such as is used in conjunction with modern lubrication systems on automobiles, is a slow and tedious procedure as well as disagreeable because of the amount of grease that is deposited on the hands during the process.

An improved method of filling, which was devised by a Washington, D. C., motorist, is illustrated in Fig. 2. It is simple enough to warrant adoption by any motorist who objects to having to fill the gun with his fingers or a stick, and is also a quicker method.

The filler is a simple, flat strip of sheet metal, fitted with a wooden handle on the upper end. The blade part passes through a slot in a cap that is of the right size to fit the grease-gun barrel. The handle, blade, and cap may be made of any available materials such as a file handle, a strip of galvanized iron, and a metal can top.

In operation the filler is inserted in the can of grease and turned continuously while it is being pulled out. The grease in the shape of a cylinder adheres to the sides of the strip. The filler then is placed in the grease gun, the cap is pushed down over the barrel, and the blade is slipped out, thus leaving the contents inside the gun.

SOME car owners, after installing bumpers on their cars, find that the extra length of the car necessitates forcing the bumper against the end wall of the garage in order to close the doors. Apart from scratching the bumper, this treatment does not improve the appearance of a light wooden or galvanized iron garage.

By cutting two lengths of old tire and securing these to the end wall of the garage in line with the car's bumper, as in Fig. 3, the shock of impact is lessened

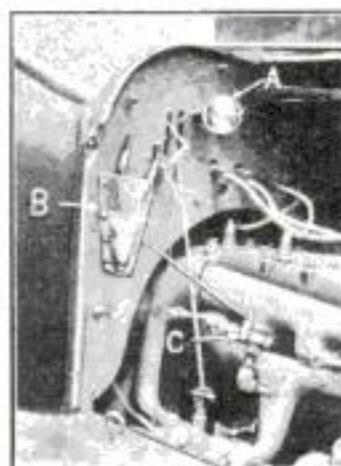


Fig. 1. Three useful additions to a Ford car

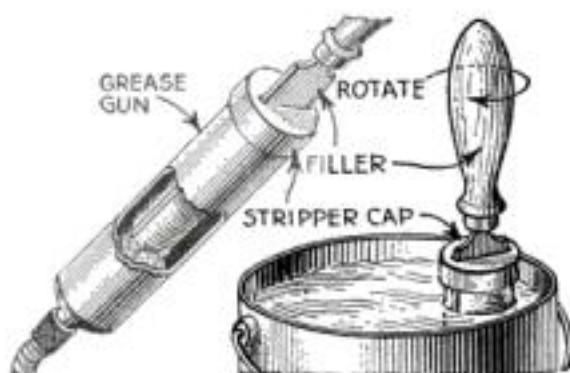


Fig. 2. Cheaply made filler saves time in charging a pressure gun with grease

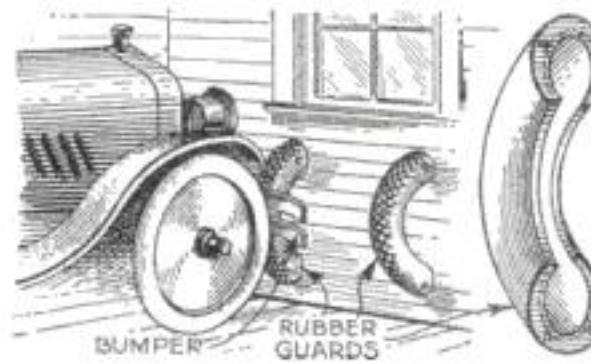


Fig. 3. Serviceable bumper guards for very small garages are made from an old tire

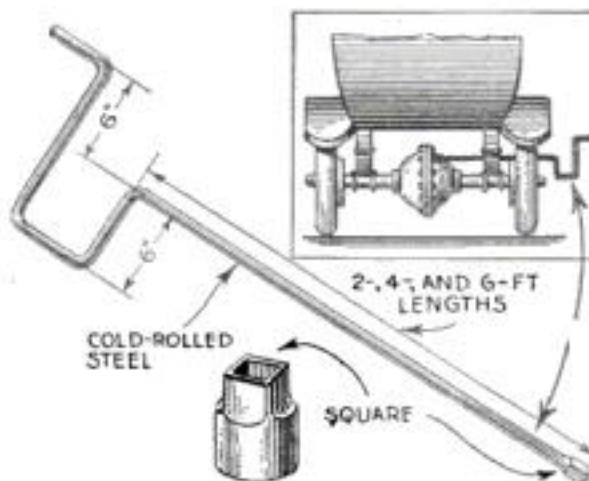


Fig. 4. Long handles for socket wrenches are useful in turning inaccessible bolts

and the bumper is saved from any chance of objectionable scratching.

IN THE chassis of the automobile and adjacent to the engine are bolts so placed in the majority of cars that they are very difficult to reach.

Certain bolts require some form of ratchet wrench to detach them. While open-end wrenches are of use, the repair work proceeds much too slowly with their use, and in the case of either type of wrench, the mechanic must get under the car or close to the bolts.

It is possible to reduce the repair time an appreciable amount by the use of

for the Car Owner

special long-range wrenches. One of the most advantageous is that shown in Fig. 4. With it mechanic or car owner can reach the most inaccessible bolts in remote parts of the chassis of a passenger car or truck.

In the illustration, a wrench of this type is shown as removing the connecting bolts in the flange of the differential housing. It will be apparent from this one use, that the operation is simplified and much time is saved.

Several handles for use with detachable sockets will cover practically all the difficult bolts about the car. Handles 2 ft., 4 ft., and 6 ft. long give a range of desirable lengths. Cold-rolled steel, which costs only a few cents a foot, is suitable for the wrenches. To accommodate the sockets, the end is squared by forging or grinding.

"**SPOOK** leaks," as they sometimes are called, are pinhole leaks in automobile inner tubes. They cannot be located while the tube is in the testing tank, but cause the tire to go slowly flat when on the car. These occurred quite often and gave the proprietor of a Wisconsin vulcanizing shop much trouble until he conceived the idea of sponging the troublesome tubes with gasoline before placing them in the tank.

It seems that small leaks of this nature are often caused by nails or brads that penetrate the rubber at an angle and leave a sort of flap in the rubber, which seals the hole and does not open under the pressure usually employed in testing. The sponging with the gasoline, however, causes the rubber to stretch more with the same pressure, thus opening the leak and allowing it to be located easily.

DRIVING a balloon tire flat is ruinous to the shoe. This is because of two conditions: the walls of the oversize tire are half as thick as the normal tire and consequently offer half the resistance to rim cutting, and, further, the small rim used inside the tire is more penetrating than the larger diameter rim, so that in the lopsided condition caused by a deflated tire there is a grinding action of the shoe between the rim and the road.

Apart from the distorted condition of a car with a deflated balloon, the traction and steering are difficult even if the tire is removed to allow running on the rim.

For these reasons every user of a balloon-tire-equipped car should carry and know how to apply patches, making the repairs at the roadside when necessary.

Preferably a small vulcanizer should be used in patching as the patches are subjected to much flexing. Cold patches are more or less uncertain. Blowout patches to place inside the shoe are required. They should be amply supple to go under the tire bead.



The Home Workshop

Arthur Wakeling, Editor

How to Do Simple House Wiring

Methods that Insure Safety in Lighting an Attic Bedroom

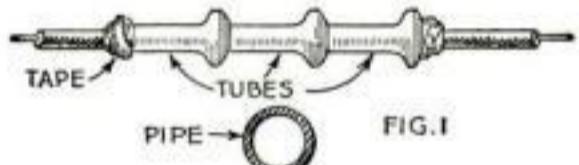
By Leroy S. Foltz

Associate Professor of
Electrical Engineering,
Mich. Agricultural College

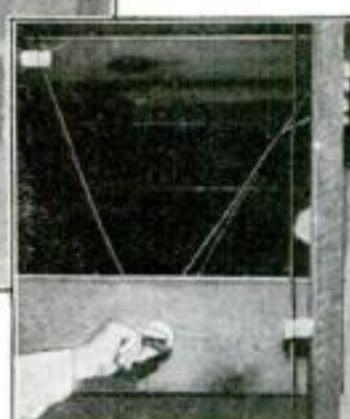
IT IS natural to desire to improve the home; the greatest drawback is the expense usually associated with it. One can take a brush and a can of paint and improve things greatly for a comparatively small outlay for materials. The labor is estimated to cost nothing, for it usually is a pleasure. There are no troublesome rules to be followed in selecting and using the materials as there are in electrical work.

However, these rules and regulations pertaining to electrical wiring need not cause dismay, as they are simple and the average home improvement job does not demand the observation of many of them.

A house-wiring job may be only the addition of an outlet to accommodate another light or plug for the iron or cleaner, or it may be the wiring of several build-



At left is open electric-light wiring in unfinished attic. Below (center) is the entrance switch, meter, fuse block, and beam cut away to show knob-and-tube wiring. At right is method of installing snap switch



or gas pipes the wires should go over the pipe. Before passing the wire over the pipe, slip three or four porcelain tubes on the wire, and when the wire is pulled tight and fastened in position, slide the tubes directly over the pipe and tape the tube ends firmly so that the tubes will not get out of place, as shown at Fig. 1.

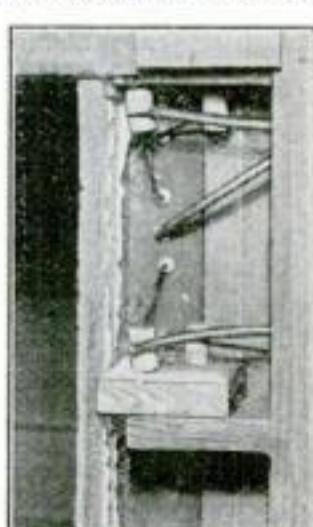
Follow this plan also when crossing other electric wires. Never pass wires below pipe unless the wires are incased in metal conduit or cable, as water may drip from the pipe onto the wires and cause trouble. A safe plan to follow in open wiring is to consider the wires as bare and so install them that the system would be safe even if the wires had no insulation on them.

Suppose we wire the floored attic so that it may be used as an emergency bedroom. Select the lamp and switch locations and wire runs, laying out the circuit as in Fig. 2.

As this will be open work, we shall use split knobs to support the wires. Each knob is supplied with a nail, and a leather washer is between the nail head and the upper half of the knob. The nail should

be $1\frac{1}{4}$ in. longer than the knob and should be driven down only until the knob is tight. In close quarters a screw may be used in place of a nail, the screw being $\frac{9}{16}$ in. longer than the knob.

To mount the lamp receptacle, cut a planed pine board to fit between the roofing timbers and after boring two holes in it, $\frac{5}{8}$ in. in diameter — near the center and almost touching each other — nail it firmly in a horizontal position (Fig. 3). In similar fashion prepare the mounting board for the upper switch, placing it with the face vertical.



How wiring is installed at stairway

ings for light and power. The agriculturist now and then must distribute electric power from his local plant to various farm buildings, but the city dweller has only small jobs to do.

To begin with, plan accurately just what is to be done. Determine the exact locations of each switch, lamp, and other fixture that is to be used. Note how the wires must be run to meet these needs. List the material as you make the survey, using a form like the following:

MATERIAL	NO.	LOCATION	REMARKS
Surface lamp switch	1	Entrance to stairs	Two-point control
Flush push switch	1	Upper hall by door	Two point control
Lamp receptacle	1	Over stairs	Porcelain, concealed wire

IN ESTIMATING wire, double all linear distances, and when counting the distance between two switches controlling the same circuit, treble the distance, as this arrangement calls for an extra wire. To be on the safe side, get 10 per cent more wire than estimated, unless the entire distance is open and visible or the circuit short.

The wires of horizontal runs must be supported at intervals of about 4 ft. and sufficient "split knobs" or porcelain cleats must be used to do this, if open-type wiring is to be installed. Where wires cross water

Mount knobs close to receptacles and switches to take any strain that might come upon the wires. To mount the

(Continued on page 126)

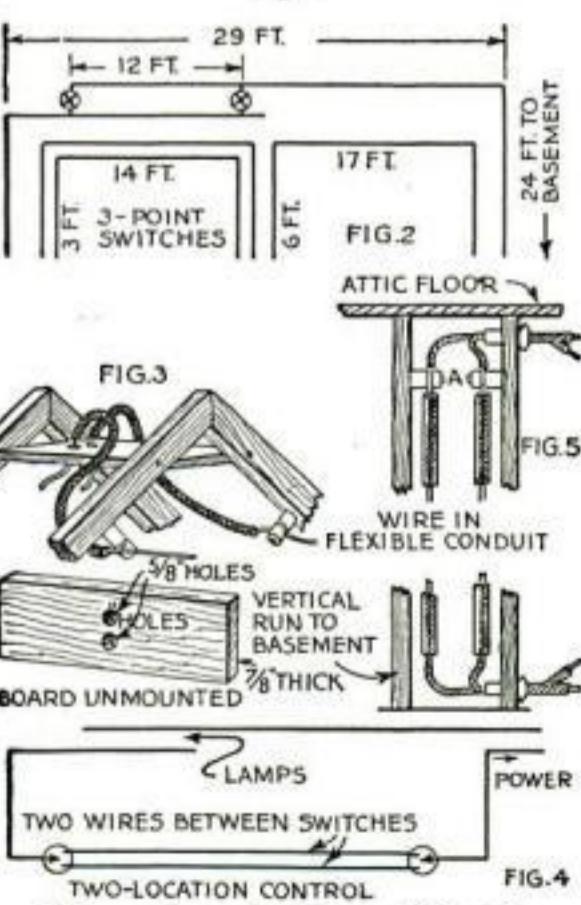


Diagram for estimating material and methods for open knob-and-tube wiring

Making a Rush-Bottom Arm-Chair

How You Can Duplicate an Early American Museum Piece

If you wish to build something especially fine in the way of furniture — something so beautiful and distinctive that you could not match it in any furniture store except at considerable cost — why not try your hand at making the rush-bottom arm-chair illustrated?

It is really a museum piece. The original, pictured in the center of the drawing, is an early American arm-chair in maple, in the Metropolitan Museum of Art, New York. Mr. George F. Kaercher, the furniture factory superintendent who details *POPULAR SCIENCE MONTHLY*'s blueprints, has taken the original design, modified it to some extent to simplify the construction, and prepared the accompanying working drawings.

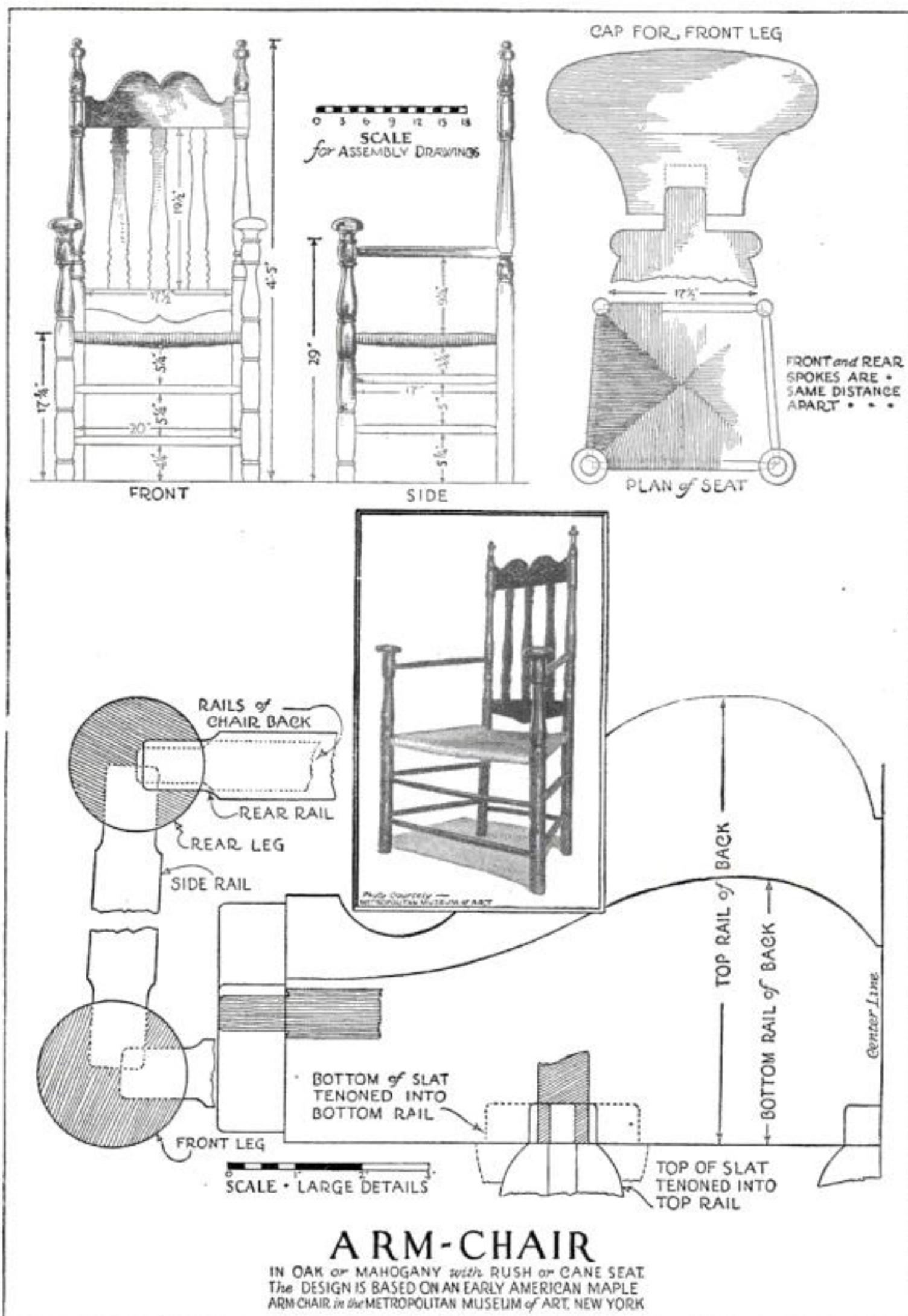
ANY one who has had reasonable experience in woodworking or has taken the equivalent of a high school course in manual training or shopwork, will have no difficulty in following the details and making the chair successfully.

It is an advantage, of course, if you have your own lathe, so that you can do the necessary turning yourself. To feel that a whole piece is entirely the work of his own hands is always a keen satisfaction to the amateur mechanic who takes pride and pleasure in his craftsmanship. On the other hand, if you do not have access to a lathe, it will cost little to have a local cabinetmaker or woodturner make the front and rear legs, the front leg caps, and the rungs. The rest you can do yourself.

While the original chair is maple, the home worker will find it best to use either mahogany, finished dark, or oak, fumed or given an old English finish. If it is to be painted, it may be made of maple or birch.

The various parts and their dimensions are as follows:

2 front legs, turned, $2\frac{1}{4}$ in. diam., $29\frac{1}{2}$ in. long
2 rear legs, turned, 2 in. diam., 4 ft. 5 in. long.
2 front leg caps, turned, $2\frac{1}{4}$ in. thick, 4 in. diam.
3 front rails or spokes, 1 in. diam., 22 in. long.
8 side rails or spokes, 1 in. diam., 19 in. long.
3 rear rails or spokes, 1 in. diam., $19\frac{1}{4}$ in. long.
1 rear top rail, $\frac{3}{4}$ in. by $6\frac{1}{4}$ in. by $19\frac{1}{4}$ in., including tenons.



IN OAK OR MAHOGANY with RUSH or CANE SEAT
The DESIGN IS BASED ON AN EARLY AMERICAN MAPLE
ARM-CHAIR in the METROPOLITAN MUSEUM of ART, NEW YORK

1 rear bottom rail, $\frac{3}{4}$ by 4 by $19\frac{1}{4}$ in., including tenons.

3 back slats $\frac{3}{8}$ by $2\frac{1}{2}$ by $20\frac{1}{4}$ in., including tenons.

A good grade of hide glue also is needed, as well as rush, imitation fiber rush, cane or woven cane for the seat.

It is most important that glue of the best grade be used, and that the rails and slats be warmed before they are put

in place. The heat will aid in making a strong joint. Use the glue hot and not too thick.

Glue should be dissolved in cold water at least 10 hours before being heated and then should not be heated too long.

Complete instructions for making the rush seat are contained in W. T. Weld's article on page 94.



Cleans, Polishes and Protects

Johnson's Liquid Wax is the ideal polish for *all* of your floors. It will make them beautiful—easy to care for—they won't be slippery—and will not heel print.

Your linoleum will last longer, look better and clean much easier if you polish it occasionally with Johnson's Liquid Wax. It brings out the pattern and color—protects linoleum from wear—and imparts a beautiful, dry, dirt-repellent surface which washes off like a piece of glass. Johnson's Polishing Wax is endorsed by all the leading manufacturers of linoleum.

The easy way to wax floors and linoleum is with a Johnson Wax Mop and Weighted Polishing Brush. No stooping or getting down on your knees.

JOHNSON'S LIQUID WAX

Johnson's Liquid Wax is the ideal furniture polish. It cleans, polishes, preserves and protects—all in one operation. It imparts a beautiful, dry, glass-like polish which will not gather dust and lint or show finger prints.

Johnson's Liquid Wax rejuvenates varnish and gives a delightful air of

immaculate cleanliness wherever used. Takes the drudgery from dusting. Easy to apply and polish.

The economical way to buy Johnson's Liquid Wax is in gals. at \$4.00, or half-gals. at \$2.40. When you start buying it in these sizes, write us for a 50c lamb's wool polishing mitt—Free and postpaid.

\$4.90 Floor Polishing Outfit \$3.50

This Offer Consists of

1—Johnson's Weighted Polishing Brush (with Wax Applier)	\$3.50
1—Pint Johnson's Liquid Wax (for polishing linoleum, floors and furniture)75
1—Pint Johnson's Kleen Floor (for cleaning floors before waxing)40
1—Johnson Book on Home Beautifying25
	\$4.90

A Saving of \$1.40

This offer is good at department, drug, grocery, hardware and paint stores. If your dealer cannot furnish the outfit, mail your order and \$3.50 direct to us and we will make immediate shipment—charges prepaid.

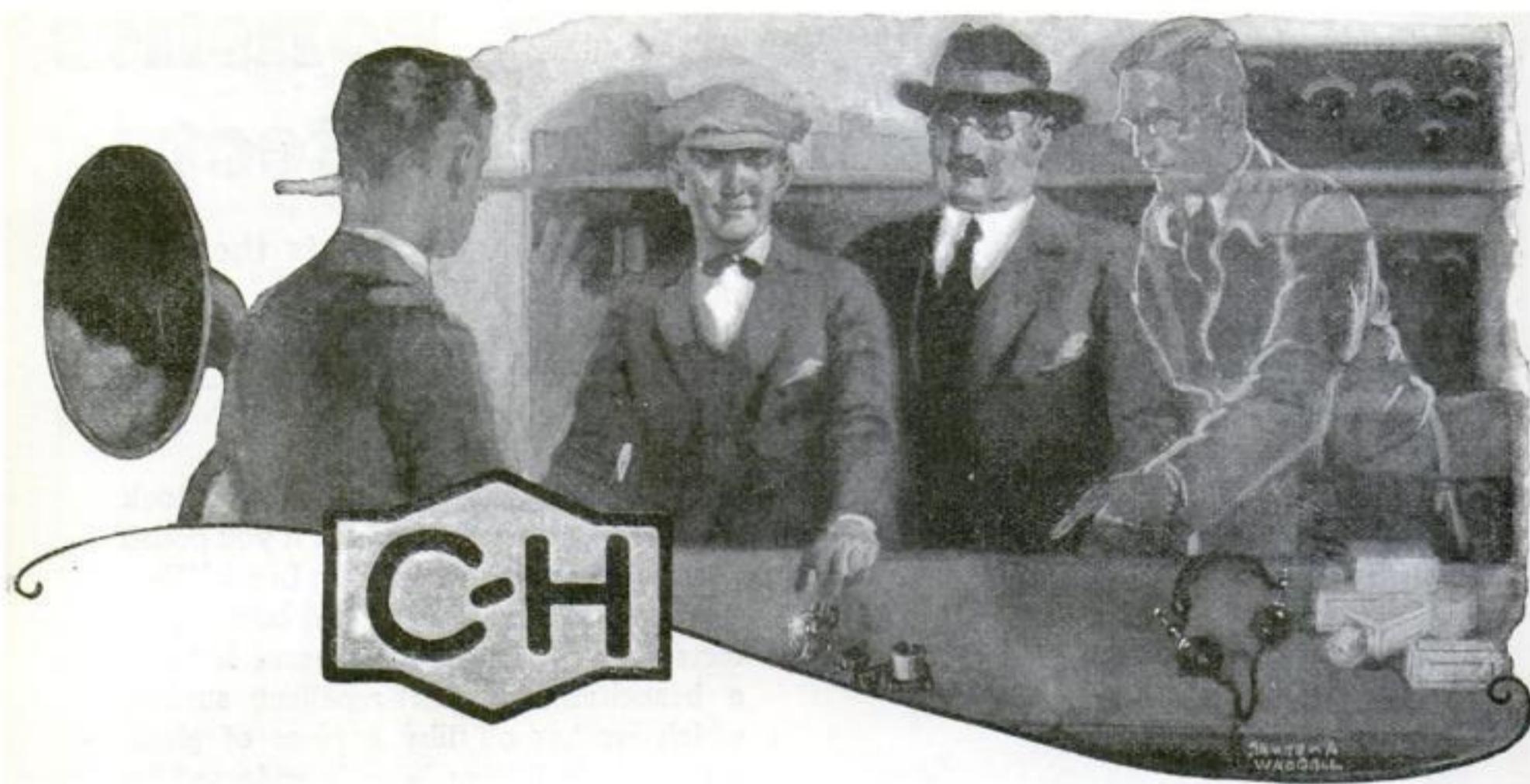
Ask for a FREE copy of the Johnson Book on Home Beautifying at Best Paint or Hardware stores in your neighborhood. Or mail us 10c to cover postage and wrapping.



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THIS SIGN

S. C. JOHNSON & SON, "The Wood Finishing Authorities" Dept. P.S. 11, RACINE, WIS.
Brantford, Canada West Drayton, Mddx., Eng. Sydney, Australia





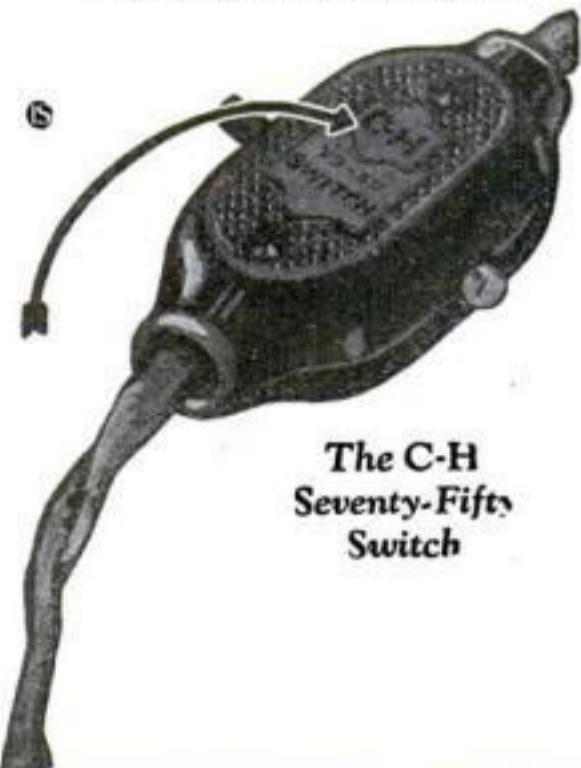
Demanding This Famous Trade Mark Is Like Having an Engineer Buy Your Radio Parts

Built into each Cutler-Hammer radio device is the experience of more than a quarter of a century in electrical control design. When you ask for this trade mark that brings you the best in engineering skill, you are doing merely what electrical engineers in industry have done for several decades.

To thousands of inexperienced radio enthusiasts, this trade mark has been the guide to success in reception—for in demanding it on the apparatus for their sets, they have obtained, without knowing just what to look for, the features and precision that radio engineers recommend.

The Name
CUTLER-HAMMER
Is Practically a Synonym
for Electrical Control

From the large controlling apparatus of giant steel mill machinery to the little 70-50 switch of which more than three million are serving on appliance cords today, the C-H trade mark is a guarantee of satisfaction. Wherever electrical control is required, the name Cutler-Hammer is in evidence.



The C-H
Seventy-Fifty
Switch



CUTLER-

COLGATE'S

Shaving Stick

"HANDY GRIP" AND REFILL



for Comfort,
Convenience,
and Economy

When we say to you that the Shaving Stick has important advantages over shaving preparations in any other form, we can do so without bias, for we manufacture shaving sticks, powder and cream.

In its attractive nickel box, our "Handy Grip" Shaving Stick is most convenient for traveling. It will not crush when packed, and it makes a wonderful lather for easy shaving. It is not uncommon for a Colgate Shaving Stick to last more than a year in daily use.

The famous "Handy Grip", with a trial-size shaving stick in nickel box, sent for 10c. When the trial stick is gone, buy Colgate "Refills" for the price of the soap alone, 25c.

COLGATE & CO.

Dept. R, 199 Fulton St.

NEW YORK

Touching the high spots of life

THREE is a wonderland of sport and adventure for either the expert or the new user in a radio instrument that is both fool-proof and capable of fine work.

You sit in your own library—you reach out into space with a simple turn of the dials and soon you have contact with—Boston or Schenectady or Pittsburgh, or perhaps some more distant point.

The thrill you get is a real one—it means another stage of amplification of man's contact with man. It means more than that to you; it means that you are bringing more and more of the world about that important centre—yourself. It means again that you are learning a new art—an art that you can carry into the finest technique if you are technically inclined, or that you can gradually improve on by merely the practice which repeated operation will give you.

Your pleasure increases with your skill

As you learn the habits of your instrument, you learn how to get satisfying results every time you try. You acquire skill in spite of yourself.

Almost any radio set can be made to work. There are several makes of good ones; and the one you should have is the one best suited to your personal requirements; but remember that for general excellence, surety and smoothness of results the De Forest D-12 stands pre-eminent.

The invention of the Audion tube by Dr. De Forest made the present high development of

radio apparatus possible. De Forest is the great name in radio. The De Forest Company has been the pioneer in simplifying the outfitting and use of radio. Our D-12 is a complete self-contained unit, with batteries, loud speaker, wires, tubes and antenna all ready for use the minute the battery wires are connected and the loop placed in position on top of the cabinet.

Without either outside antenna or ground wire it does its perfect work. With outside antenna and ground wire it may extend its range somewhat in special circumstances.

Its four tubes do the work of seven

It is built for convenience, and for exactness and economy of operation. Its four tubes do the work of seven, and do it better. It is easy on batteries, and above all, De Forest has won an outstanding reputation in the industry by years of notable performance. It is an instrument you will be proud to own and tell others that you own.

Every great industry has its great standardized product, known by the public for its efficiency, its reliability, and its honestly earned reputation. In the automobile field, the talking machine field, the piano field, there are such. You probably can name them. In the radio field its name is De Forest.

Economical to use

It is not a "cheap" instrument, because such standardized performance as the De Forest D-12 will give you is not a cheap thing, and the instrument is worthy of the attractive housing which it has; but it is most economical to use, because

©

DE FOREST D-12 RE-

Your receiver deserves De Forest Tubes

YOUR radio set is no better than its tubes—for volume and beauty of tone reproduction you must rely on them.

De Forest tubes satisfy the requirements of the most exacting set owner. They are the latest developments in the manufacture of tubes begun many years ago, when Dr. Lee De Forest invented the three-electrode

vacuum tube which makes present-day radio possible.

For volume and beauty of tone De Forest tubes are unsurpassed. They are non-microphonic—do not ring or sing or howl. They use little current, and last long.

For dry batteries use the De Forest DV-3. This tube is specially adapted for use on camping

trips, and for general use in locations where there is no electric power.

For storage batteries make sure you have the DV-2. With these tubes you can operate practically every circuit in use today.

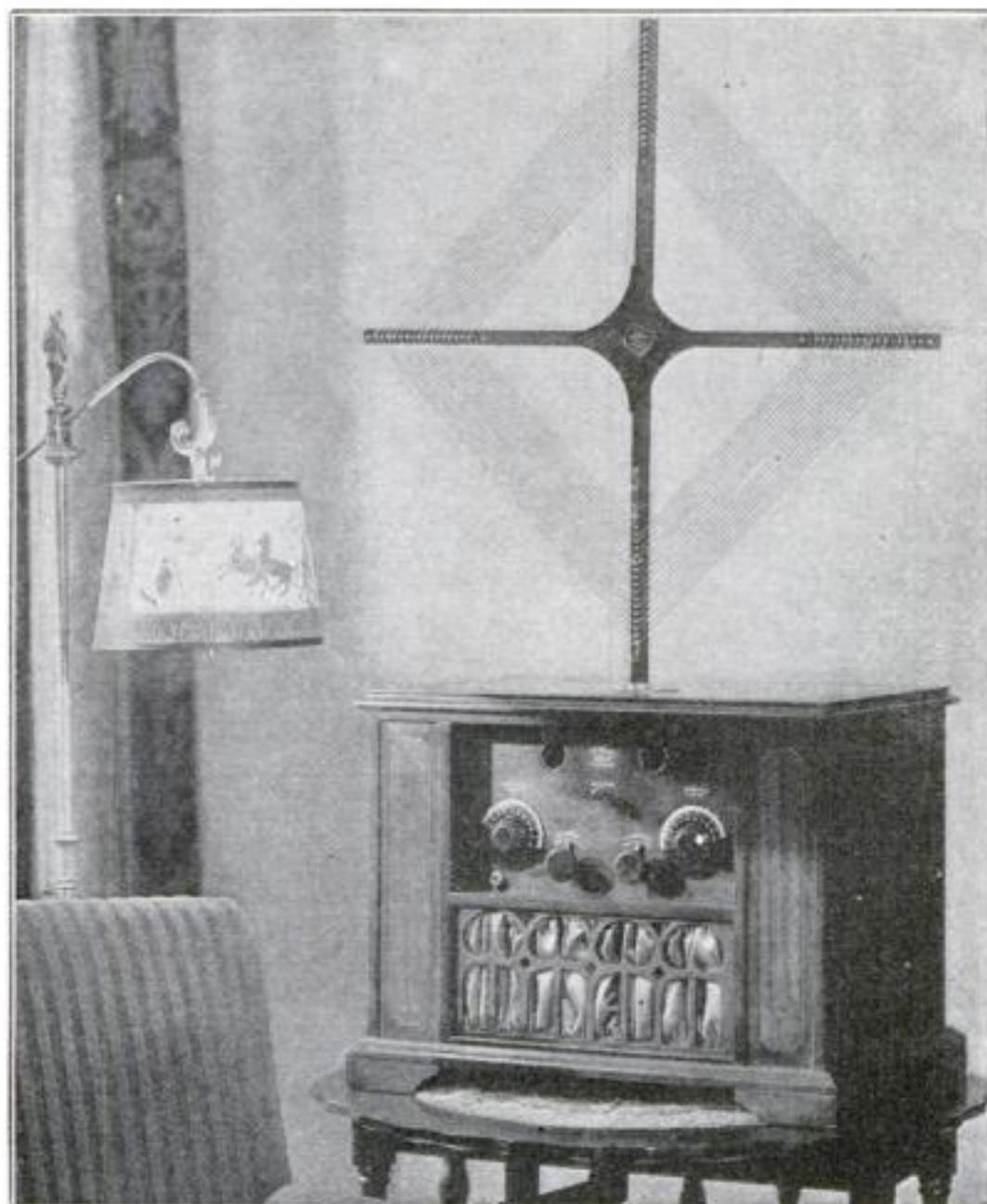
The name De Forest on these tubes is a guarantee against de-

fects in material, character and workmanship. All De Forest tubes are inspected thoroughly during and after production and are tested. They are packed in individual cartons containing instructions for proper operation and connection. Sold only by authorized De Forest agents. Look for the name De Forest on each tube.

once adjusted it works most satisfactorily, and takes the minimum of current for operation. Though it is not "cheap," it is very low-priced in comparison with any other radio set that will give equal or approximately equal results.

This radio industry is beyond its "pin feather" or elementary experimental stage. The radio receiver was really invented when Dr. De Forest invented the Audion tube—although the world didn't know it for several years.

Good receiving sets today are standardized. You will no more throw away your radio after a year or so than you will throw away your good piano. The De Forest Radio is here, and here to stay.



There is much splendid broadcasting being done today—and it will be better tomorrow—but the so-called "latest word" in receiving sets does not differ in essential principles from that of several years ago—just as the automobile of today's purchase is in essentials the same as the car of the same name was several years ago. Don't be fooled on this. The De Forest Radiophone you buy now will be essentially up-to-date for years.

It is as simple as eating to use the De Forest D-12

You learn how to catch the good things as you follow the broadcasting programs; that is fun. You learn how to get the reproduction clear and strong; that is fun. You learn the delicate art of picking up distant stations, and that is heaps of fun. You learn what radio won't do in the summer and what it will do in the winter. You learn its whims and whimsies. You learn it is as interesting as a beautiful girl; as temperamental as an artist, and you learn to be a master of its whims and temperaments.

You may do this with or without learning its mechanical and scientific principles. Suit yourself. It is fun either way.

Here are directions for using De Forest D-12:

Have your dealer deliver the instrument to you—put the loop into its place, turn the dials till you get your station (your dealer will show you how) and then your fun begins. Listen and change your stations to your heart's desire.

**DE FOREST
RADIO TEL. & TEL. CO.
Jersey City, N. J.**

FLEX RADIOPHONE

De Forest D-12 Reflex Radiophone

A four-tube, long distance indoor loop receiver, with self-contained batteries and loud speaker

1. COMPACTNESS—Completely self-contained in beautifully designed case with two foot antenna. No bothersome aerial and ground wires, or outside batteries or loud speaker.

2. SIMPLICITY—Controls simple enough for the veriest amateur, critical enough for the expert. Calibrated tuning chart with each set. Raising the cover makes all parts accessible.

3. EFFICIENCY—Six stages of amplification and one stage detector gives high selectivity on this four tube circuit. Tuned radio. Volume controllable from faint whisper to the crashing of a brass band, with perfect fidelity of tonal quality. Great distance range.

4. ECONOMY—This four tube reflex circuit cuts cost of tube replacement and battery upkeep. If more than five tubes

are used the "B" batteries are used up at ruinous rate.

5. MOBILITY—The D-12 is so light and compact you can easily move it from room to room and is so well built that this will not put it out of commission. Can easily be carried in the tonneau of your car. Some users install it on a tea-wagon. The leather covered set will not mar easily.

6. BEAUTY—This is the smartest and handsomest moderate priced set, in either its embossed two-toned leather or its piano finished two-toned mahogany case.

7. Remarkably low price. The De Forest D-12 Reflex Radiophone is several hundred dollars below any other set that compares with it in distance range, efficiency or beauty.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

Tools for radio building

Half the fun of having a radio is in building it yourself. Here are a few essential tools that every radio "fan" should own:

Sensitive Drill No. 656

Price \$2.30

The handiest tool ever designed for drilling small holes in and behind radio panels where space is congested. It gets into places where a hand drill or bit brace cannot reach.

The forward and backward movement of the traveling handle drives the spiral and chuck continuously to the right. The all-steel chuck holds all round shank drills from 0 to $\frac{1}{4}$ inch.

"Hex" Socket Wrench Set No. 673

Price \$1.50

Has three interchangeable "hex" sockets— $\frac{3}{16}$, $\frac{5}{16}$ and $\frac{1}{4}$ inch between flats. Also a four-jawed socket for tightening and loosening thumb screws on dry cells, etc.

Square end of shank is split and spread so that sockets are held tightly. Sockets are drilled sufficiently deep to allow plenty of room for screw ends.

Tool Set No. 674

Price \$2.40

Wrench Set as described above with additional equipment of a $6\frac{1}{2}$ inch and an 8 inch slim screwdriver for binder screws, etc.

Countersink No. 652

Price 40c

Made with round shank to fit three-jawed chucks of $\frac{1}{4}$ inch capacity or more (such as the No. 656 Sensitive Drill shown above).

This is a two-lipped cutter with unusually large chip clearance. Cuts fast in bakelite, fibre, iron, copper or wood.

GOODELL-PRATT COMPANY
GREENFIELD, MASS., U. S. A.

 Toolsmiths
Makers of Mr. Punch

NO. 656



NO. 652



GOODELL-PRATT

1500 GOOD TOOLS

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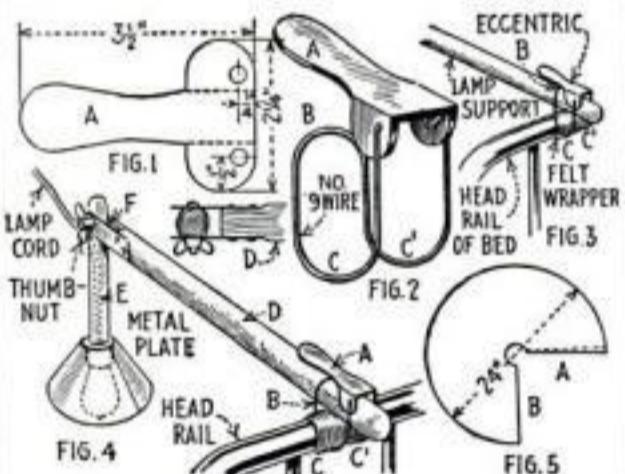
Cheaply Made Bed Lamp Has Universal Adjustment

THOSE who like to read while resting in bed will appreciate this easily made adjustable lamp. Cut from 16-gage sheet steel a piece like A, Fig. 1.

Drill the two holes indicated, to accommodate a 9-gage wire, and bend the two tips along the dotted lines, changing the piece to the form of A in Fig. 2.

Cut from a broom the handle D (Fig. 4), 30 in. long. Bend a wire as shown in Fig. 2 so that the curve at B will fit D. With D in place over the head rail of the bed and through loop B, bend the ends of the wire round the rail as in Fig. 4, forming curves C and C'. Now, with the eccentric A turned upward at right angles to D, bend the ends of the wire at right angles and hook them in the holes in A (Figs. 2, 3, and 4).

This makes an effective clamp as, when the handle of the eccentric is turned down (Figs. 3 and 4), the wire is tightened and



Details of the lamp support and the eccentric clamp that fastens it to the bed

D is held rigidly in contact with the head rail. It is advisable to wrap the latter with felt or heavy paper to prevent injury to its finish.

Metal plates drilled for screws and for a carriage bolt (F, Fig. 4) are attached to one end of D. E is a piece of broom handle 6 in. long. It is drilled longitudinally as indicated by the dotted lines to receive the lamp cord and transversely for the carriage bolt, F. At the lower end of E is a cap socket, attached by means of a bushing.

The shade may be made from cardboard, parchment, or a good grade of drawing paper. A 24-in. disk, cut as in Fig. 5, produces a shade of satisfactory size and shape when the edges, A and B, are brought together and glued or stapled along the dotted line.

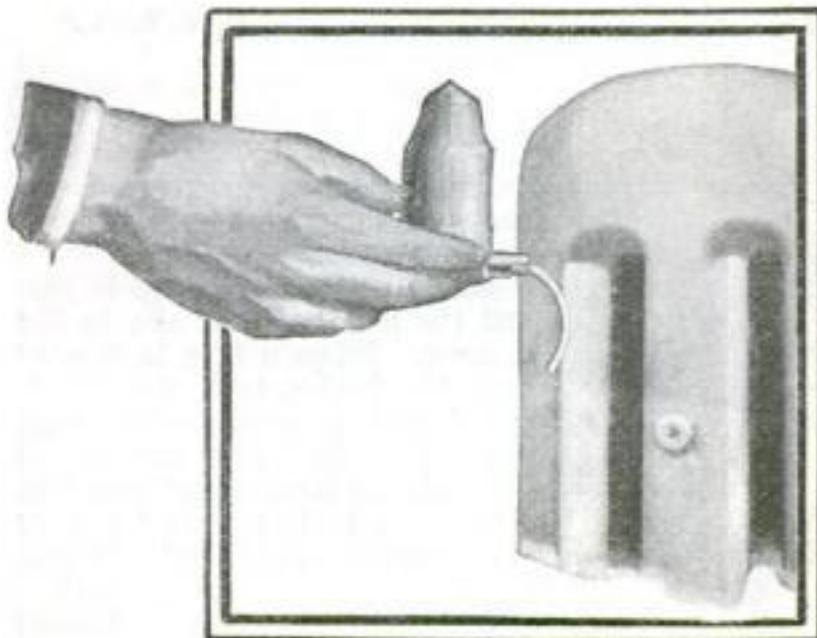
A beautiful effect is obtained by treating a drawing-paper or parchment shade with linseed oil to render it translucent and then applying to it a painted or stenciled design.

The metal parts of the support should be coated with black enamel. The wood may be painted similarly or stained and varnished as desired.

Obviously, E may be set at any angle desired by loosening the thumb-nut, F. When the clamp at the other end of D is loosened, the light may be moved forward or backward.

The arm D also may be turned upward or downward and locked at any angle.—HOWARD E. GOOD, Waterville, Ohio.

New device makes *cold radiators hot*

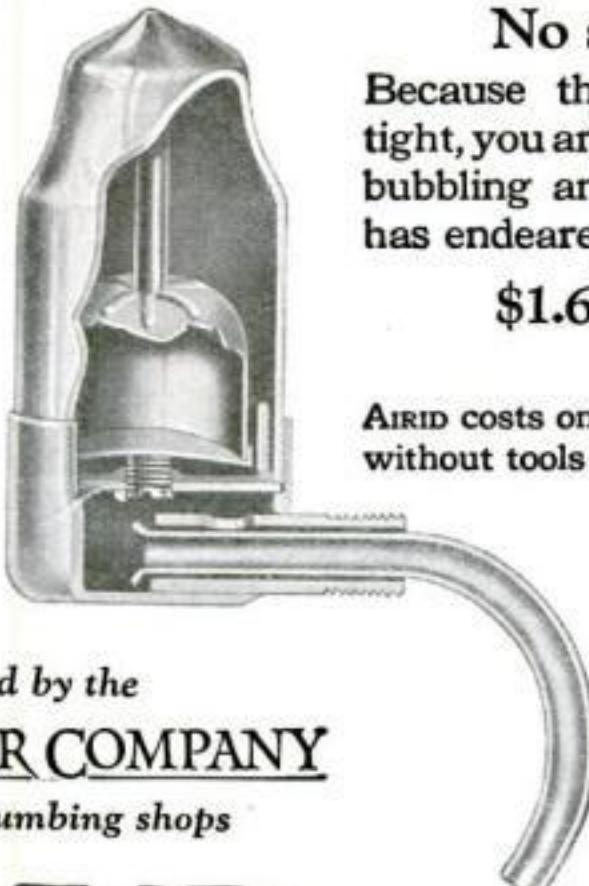


Intelligent float knows the difference between air and steam

Inside the AIRID is a metal float, and inside the float is a volatile liquid—the "brains" of the valve. Cold air flows around the float, up through the vent-hole and out. Then steam enters the chamber of the valve, and that is the signal for action. Instantly the liquid inside expands, swelling the sensitive metal bottom of the float enough to raise it from its first position and to thrust a top pin up into the vent-hole. Thus the vent is closed and stays closed as long as the steam is on!

Not even water can escape

Water is present in almost every steam heating system, and AIRID knows how to deal with it, too! The "float" literally floats on the rising water until the opening is closed by the metal pin, as before. The water runs back into the radiator, not out on the floor.



Made and guaranteed by the
AMERICAN RADIATOR COMPANY

Sold at all heating and plumbing shops

AIRID AIR-VALVES

MAKING HOT RADIATORS out of cold ones, is the achievement of an invention called AIRID. The name originates in the operation of this ingenious contrivance which "rids" the radiator of "cold air." AIRID is a perfected air valve which performs its duty under all possible conditions, permitting the steam to push the air out, but preventing the escape of the steam itself.

Despite the mechanical nicety of AIRID, it is so simple that anyone can attach it to any steam radiator without tools in about two minutes. After that, the action is entirely automatic.

Why steam radiators are partly cold

Whenever steam travels through the pipes of a heating system, it pushes air ahead of it.

The radiator is the end of the journey. There the air packs into the radiator, and acts as a barrier against the steam; hence the frequent complaint that the radiator is "half cold." AIRID lets this cold air out; but that's only half the story.

No sputtering or sizzling

Because the AIRID vent shuts absolutely tight, you are spared the misery of sputtering, bubbling and sizzling. This feature, alone, has endeared AIRID to many home owners

**\$1.60—little enough for
a hot radiator!**

AIRID costs only \$1.60. The installation can be made without tools in about two minutes.

From the moment AIRID begins to work, your radiator is hot—permanently.

Send the coupon with
\$1.60 and prove this
to your own satisfaction in your
coldest room

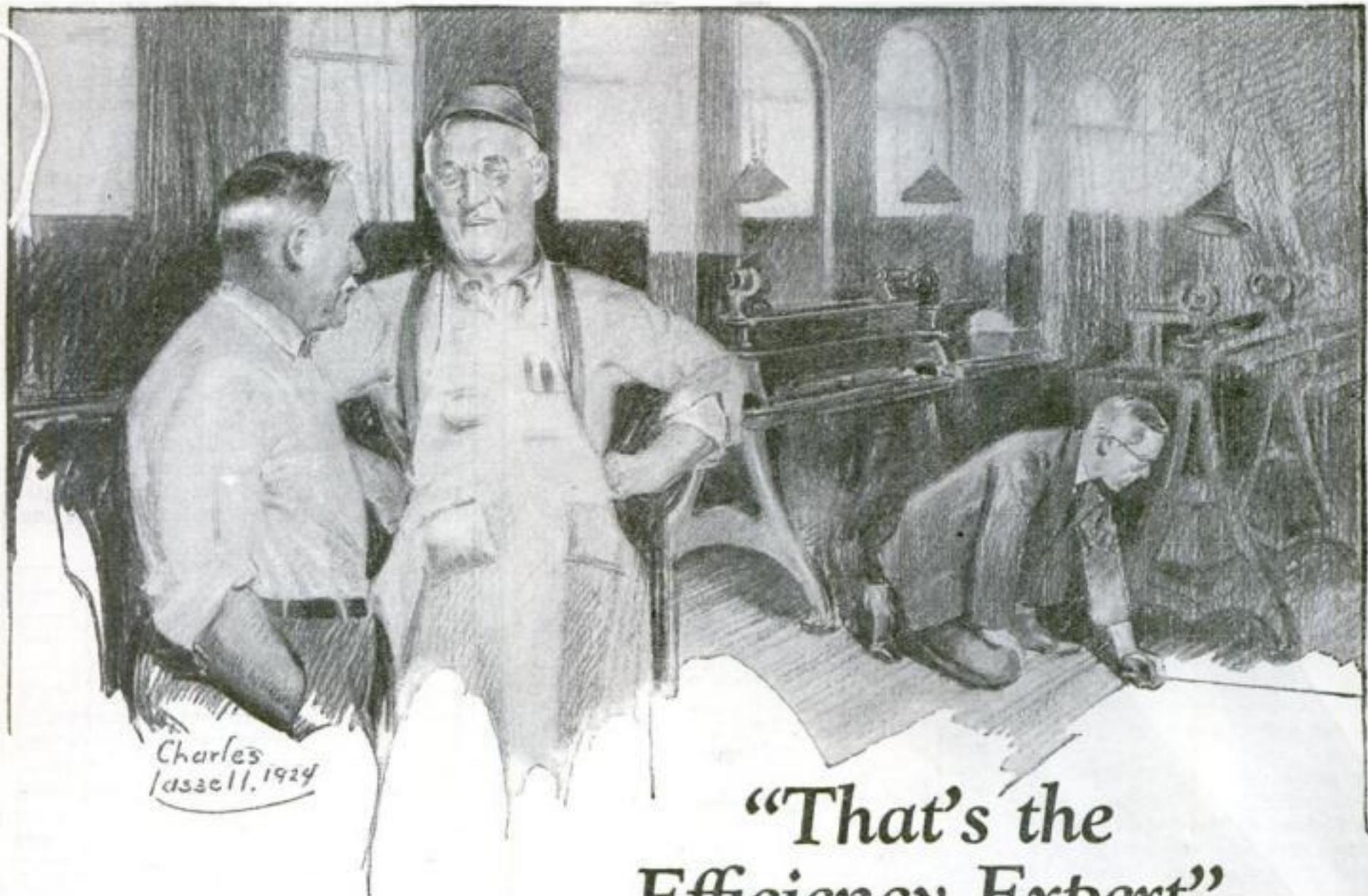
AMERICAN
RADIATOR
COMPANY

Specialties Department
1807 Elmwood Avenue
Buffalo, N.Y.

I am enclosing \$1.60 for an AIRID Air Valve to make my coldest radiator hot.

Name

Address



"That's the Efficiency Expert"

"Going to show us how to speed up production and eliminate lost motion in the shop."

"And trying to get accurate measurements with a woven tape! For Pete's sake, let him take your Starrett. If he thinks as much about *his* time as he does ours, he'll thank you for it."

QUICK READING

The steel-bright figures and graduation marks on a Starrett Tape show up plainly against the jet-black background. As a further aid to fast, accurate reading the foot figure is placed alongside each inch mark so that the measurement in feet and inches can be seen at a glance. And Starrett Tapes being made of a fine quality steel do not shrink or stretch—they are indispensable where close measurements are required over comparatively long distances. For sale at good hardware stores everywhere. Write for the Starrett Catalog No. 23 "W" for description of the many different sizes, graduations, etc.

THE L. S. STARRETT CO.

World's Greatest Toolmakers—Manufacturers of Hacksaws Unexcelled
ATHOL, MASS.

6956

Starrett Steel Tapes



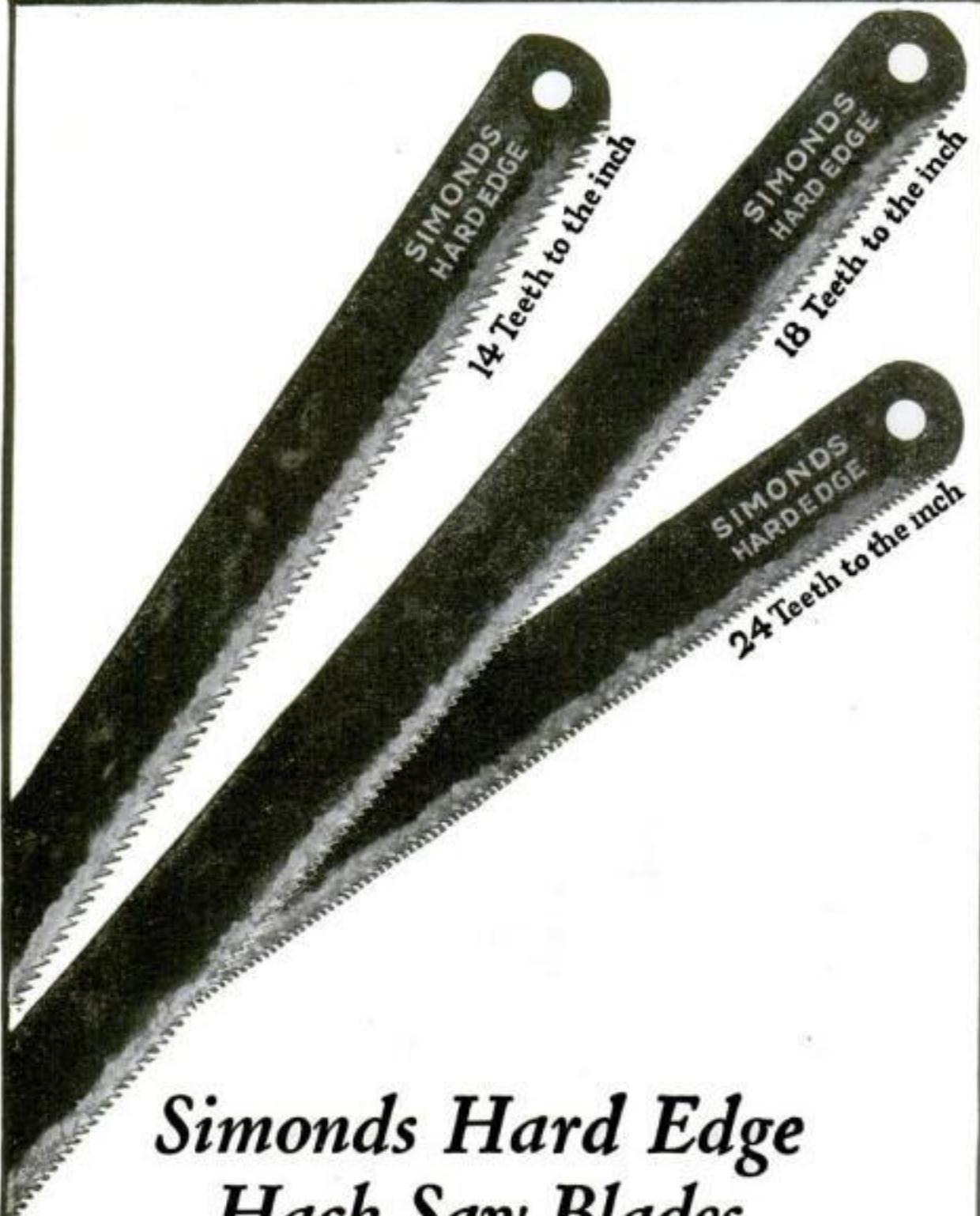
AUTO-MECHANICS!

Get "The Starrett Book for Motor Machinists and Auto-Repairmen" at any hardware store selling Starrett Tools. Or write us. Costs only 75 cents and a good buy at four times the price.



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A SIMONDS hack saw blade for every hack saw purpose



Simonds Hard Edge Hack Saw Blades

Practically unbreakable—double flexibility—will not shell teeth. Will reduce your blade expense fifty per cent. Made from Simonds Steel specially heat treated to give maximum wear. Sample eight or ten inch blade sent on request—FREE.

SIMONDS SAW AND STEEL COMPANY
"The Saw Makers" Fitchburg, Mass. Established 1832
Branch Offices in Principal Cities

SIMONDS
Pronounced SI-MONDS
SAWS FILES KNIVES STEEL

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Measuring the Contents of a Horizontal Cylindrical Tank

GARAGE owners, factory storekeepers, and any one who has occasion to measure gasoline, oils or other liquids stored in horizontal cylindrical tanks, know how difficult it is to tell exactly how many gallons are on hand. This can be done, however, by making a special measuring rod, preferably of wood, on which is marked the capacity of the tank in gallons at each inch of depth.

To figure this by simple arithmetic, lay out a circle the exact inside diameter of the tank and draw horizontal lines 1 in. apart, commencing at the bottom. Then draw a vertical line up from the ends of each horizontal line as illustrated. Measure the length of each of the 1-in.-wide rectangles so formed and add the length of the base of the triangular space at one

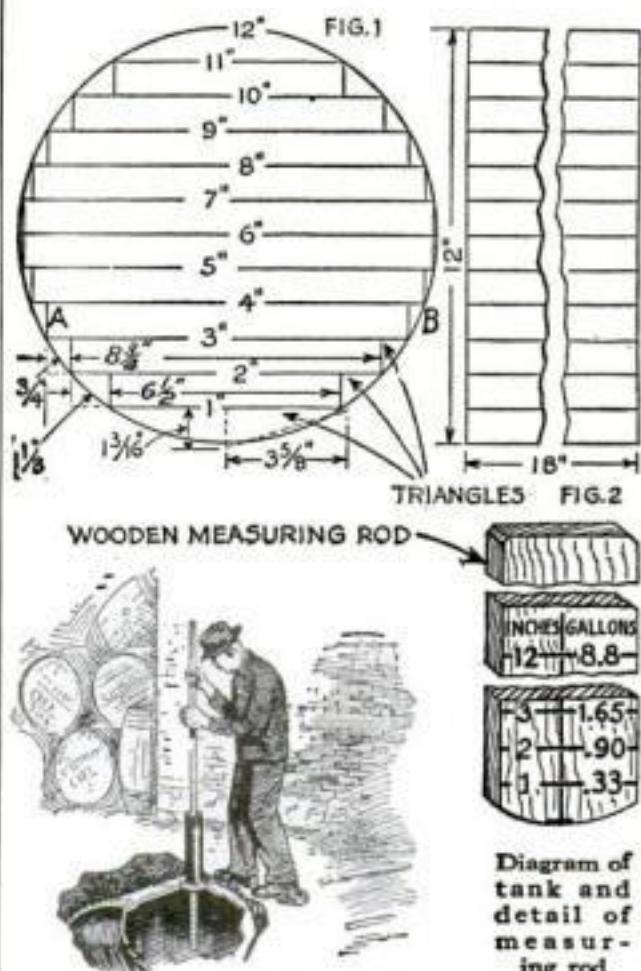


Diagram of tank and detail of measuring rod

EXAMPLE
 $1 \text{ in.} - 3\frac{5}{8} \times 1\frac{3}{16} \times 18 \div 231 = .33 \text{ gal.}$
 $2 \text{ in.} - 6\frac{1}{2} + 1\frac{1}{8} \times 18 \div 231 + .33 = .90 \text{ gal.}$
 $3 \text{ in.} - 8\frac{3}{4} + 3\frac{1}{8} \times 18 \div 231 + .90 = 1.65 \text{ gal.}$

side; in other words, the distance from A to B in each case. Then multiply this by the inside length of the tank. This gives the number of cubic inches in each layer, except the lowest and highest.

The lowest division of all is best measured by drawing a right triangle to approximate as nearly as possible the area, as indicated by the dotted lines. Then multiply the base and the height of this triangle, and multiply the product by the length of the tank; this gives the number of cubic inches in the bottom layer. The top layer can be figured in the same way.

The number of cubic inches in each layer then is divided by 231 (which is the number of cubic inches in a gallon), which gives the result in gallons.

On the measuring rod is marked both the inch divisions and the gallon capacity of the tank at each inch level. The marks should be varnished for protection.

In the case of large tanks, the diagram can be drawn on a reduced scale.

*The
new*

CORONA FOUR



STANDARD FOUR-ROW KEYBOARD!
Office sturdiness! As wide as the heavier makes, but built lower. Corona now brings you, for the first time in typewriter history, a model that meets every office requirement—and yet is portable.

It is light to the touch, quiet to the ear, a delight to the eye. Every time-saving feature is there, from self-spacing carriage return to 12-yard self-reversing ribbon.

Look for "Corona" in your telephone book or send the coupon below for the whole story of Corona Four.

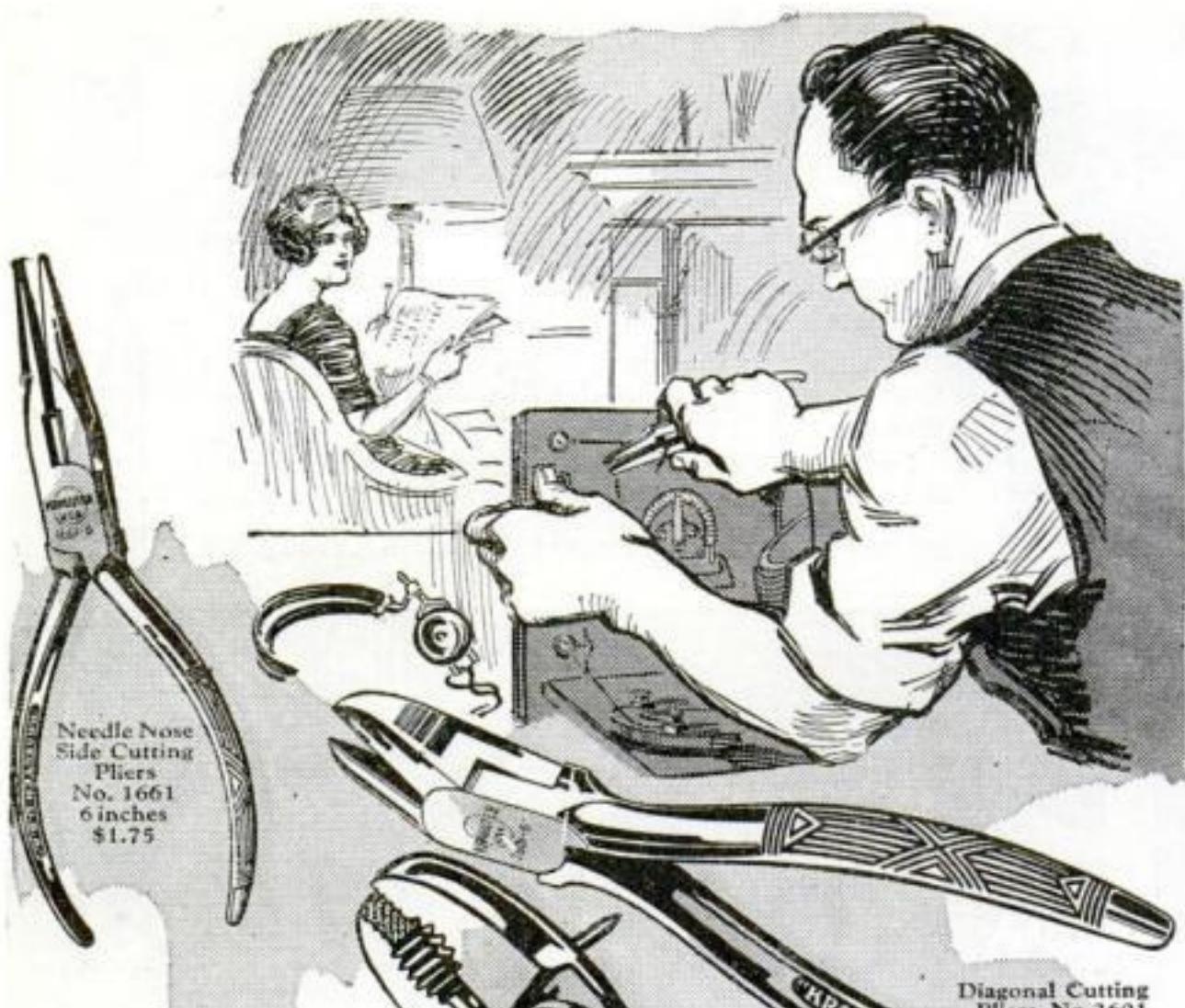
CORONA TYPEWRITER CO., INC. 112 Main Street, Groton, N.Y.

CORONA TYPEWRITER CO., INC.
112 MAIN ST., GROTON, NEW YORK
Please send me full information
about Corona Four and the address
of the nearest Corona Store

Name _____

Address _____

City _____



Just the Right Pliers for Every Job

WHY do you always see the handles of Kraeuter Pliers sticking out of the pocket of a first class mechanic's overalls?

For the same reasons that YOU ought to use them.

They stand up—long after ordinary pliers would be thrown on the junk pile.

Their teeth grip tight and hang on—because they are tempered with scientific accuracy, and neither mash down nor break off.

Their wire-cutters really cut—not only when new, but during many years of continued use.

You men who use pliers for your radio set, automobile, or tool cabinet should have a pair.

You'll find just what you want, among the 120 styles and sizes.

For sale wherever good tools are sold—80c up.

"Ask Any Mechanic"

KRAEUTER
PLIERS and TOOLS
Newark, N.J. Established 1860

Electrician's
Side Cutting
Pliers
No. 1831
7 inches
\$1.40

Solid Die-Holder for a Lathe Tail Spindle

TO GUIDE by hand a threading die over the end of a rod or shaft that is turning in the lathe, is far from an accurate or satisfactory method. Without much work it is possible, however, to provide a lathe with the die-holder shown. This holds the solid die perpendicular to the work and at the same time has a positive release grip.

A circular sleeve is provided with a setscrew and a guide screw. This sleeve fits snugly into a collar that has a slot for the guide screw to permit longitudinal movement. The rear end of the collar is split and fitted with a bolt to clamp on the lathe tail spindle after the lathe center has been removed.

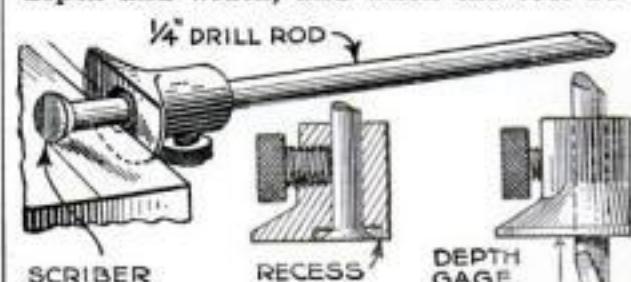
When the die strikes a shoulder or runs the limit of the guide, the grip over the tail spindle simply slips around without damage.—G. A. L.

Solder Aids in Tempering

A PIECE of soft solder will serve as a guide for drawing the temper on tools and dies. After the die or tool is hardened, heat a flat plate of suitable size to support the job, and place the die or tool on this plate. The correct temper is found by applying the solder at short intervals in several spots or in the particular locality where the temper is wanted. When the die is hot enough so that the solder just sticks, the tempering should be stopped by plunging the work in cold water. This is equivalent to what is familiarly known as dark brown or straw color. The method is useful for one with poor eyesight or in places where the light is not good for watching colors.

Round-Blade Scriber Is also Useful as Depth Gage

THE scriber shown is excellent for marking parallel lines. The beveled edge cuts a sharp, true line of uniform depth and width, and when the tool be-



Useful as a scribe for parallel lines, this tool serves also as a depth gage comes dull, a slight turn of the rod presents a new cutting face. Not until the edge has been turned all the way around does it require regrinding.

By reversing the rod in the holder, the tool becomes a convenient depth gage.

After the tool has been used, the rod is pushed back until the cutting edge of the scribing disk is sunk flush into a recess, which protects the edge from damage or injury.—H. S. L.



PRICE
\$10

S

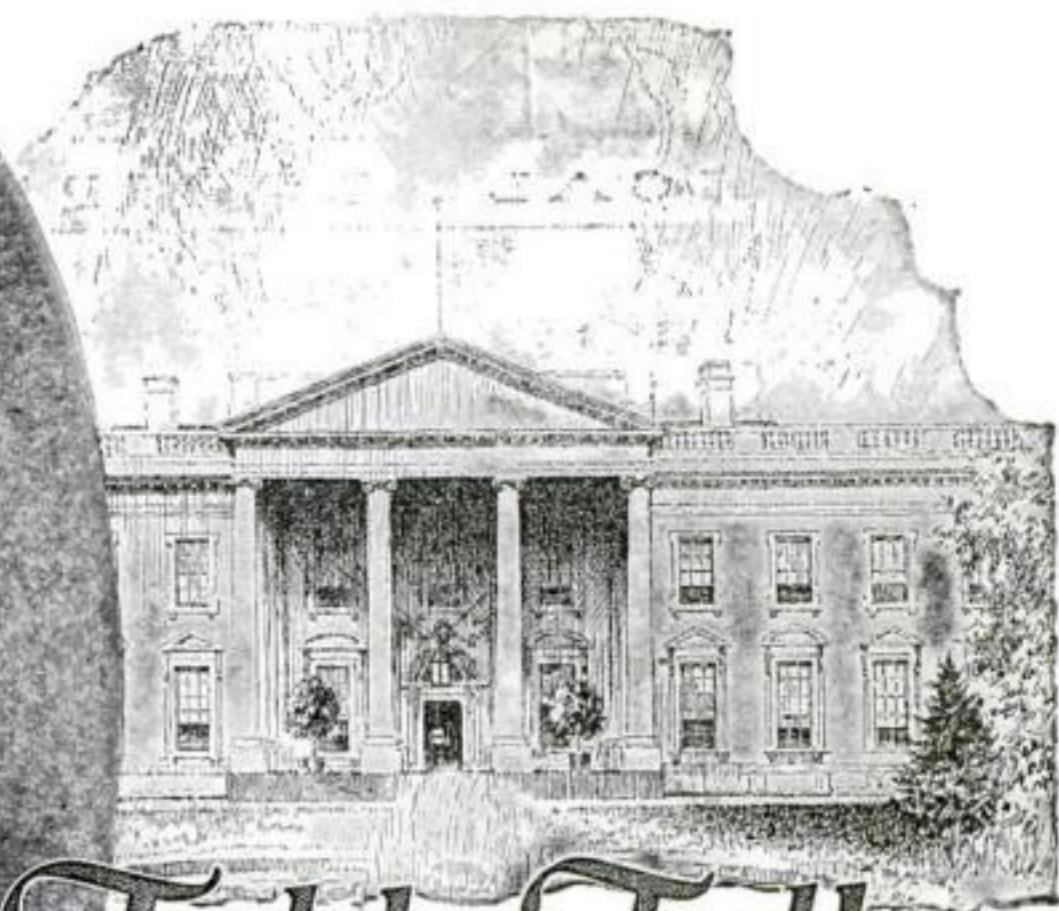


Table-Talker

Keep in touch with
National Events

The final desperate spurt as the Presidential campaign draws to a close! The returns as they pile up on election night. Great speeches and vital messages—the inaugural address, the later congressional messages—hard, slow reading, but easy to listen to—with a *Table-Talker*.

And, too, there's everything from football to recipes, from grand opera to market reports, from prize fights to bedtime tales. All brought to your home—shared with your family and your friends by the real reproduction of the *Table-Talker*.

Brandes

*The name
to know in Radio*



© C. Brandes, Inc.

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*All aboard,
Boys - for the best fun ever!*

YOU boys like something new — something different. Ives wonderful electrically-reversing locomotive is both. It's a new and revolutionary invention—the only toy locomotive in the world that will reverse electrically without being touched by hand. The same control switch regularly operating any electric locomotive also operates the reverse mechanism in this new one on any regular $2\frac{1}{4}$ gauge track.

Open the control and, with headlight blazing, each car illuminated, speed over your own branch of the Ives Railway Lines—a system with trackage

sufficient to extend from New York to San Francisco including branch lines, indoors and out, all over the country.

Ives Toys make happy boys

THERE'S an Ives Train to suit every purse and to give pleasure to boys of every age. No matter whether you have the train illustrated above, No. 704-R, with electrically-reversing locomotive and individually lighted cars, running on $2\frac{1}{4}$ gauge track—or train No. 505, a snappy little train that costs only \$5.75 and runs on 0-gauge track—your fun will be all the same.

THE IVES MANUFACTURING CORPORATION
197 Holland Avenue Bridgeport, Conn.

IVES ELECTRIC AND MECHANICAL TRAINS

Send for fascinating booklet

OUR new 32-page book in color illustrates and describes the complete line of Ives Trains and accessories, including the electrically-reversing locomotive, passenger and freight cars, bridges, switches, stations, automatic bell signals for crossings, automatic block semaphores, etc. A copy will be sent you for 10c. Mail the coupon today.

Ives Trains are sold by toy, department, electrical and hardware stores everywhere.



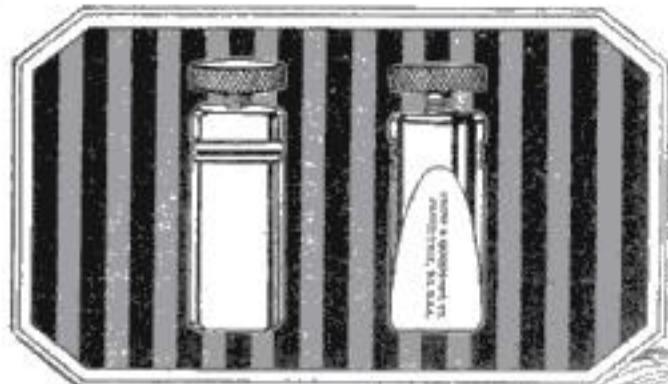
THE IVES MANUFACTURING CORP.
197 Holland Avenue, Bridgeport, Conn.
Please mail me your 32-page railroad book illustrated in colors, showing the complete line of Ives Trains, Locomotives, New Signals and Accessories. I enclose 10 cents (U. S. stamp or coin).

Name.....

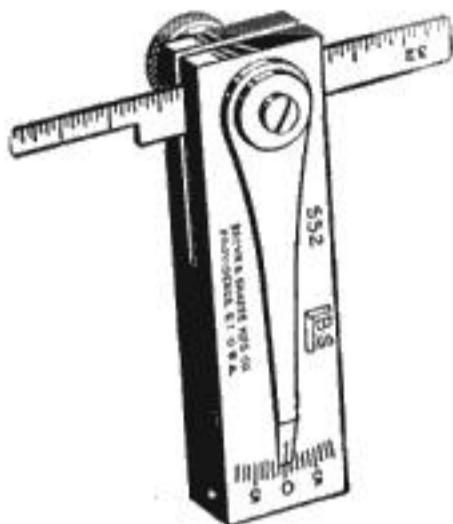
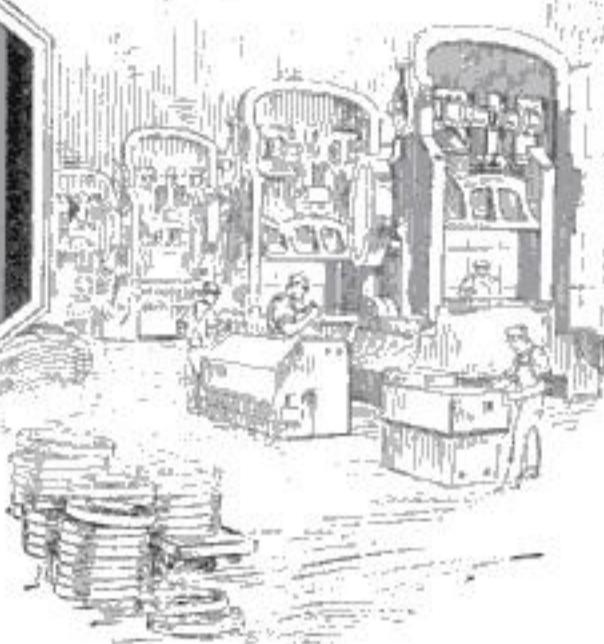
Address

City..... State.....

NEW TOOLS ~



Key Seat Clamps No. 377



One Makers' Square No. 55



Inside Micrometer No. 26



Taper Parallel Gauges No. 672

Designed to help you do more accurate work

THESE new Brown & Sharpe Tools contain the time and labor saving features in which you are interested. The new features help you to do more accurate work.

Experienced tool designers have made possible these tools for you. They have studied your more exacting requirements and experimented with new designs and models—always with the one object of providing tools that will enable you to accomplish your work in an easier and more accurate way. They are tools from which you will receive the accuracy and efficiency that you must depend upon.

A few of these new tools are illustrated on this page. Many others are described in our new No. 29 Small Tool Catalog. Write for a copy today.

Brown & Sharpe Mfg. Co.
Providence, R. I., U. S. A.

BROWN & SHARPE TOOLS

Standard of the mechanical world

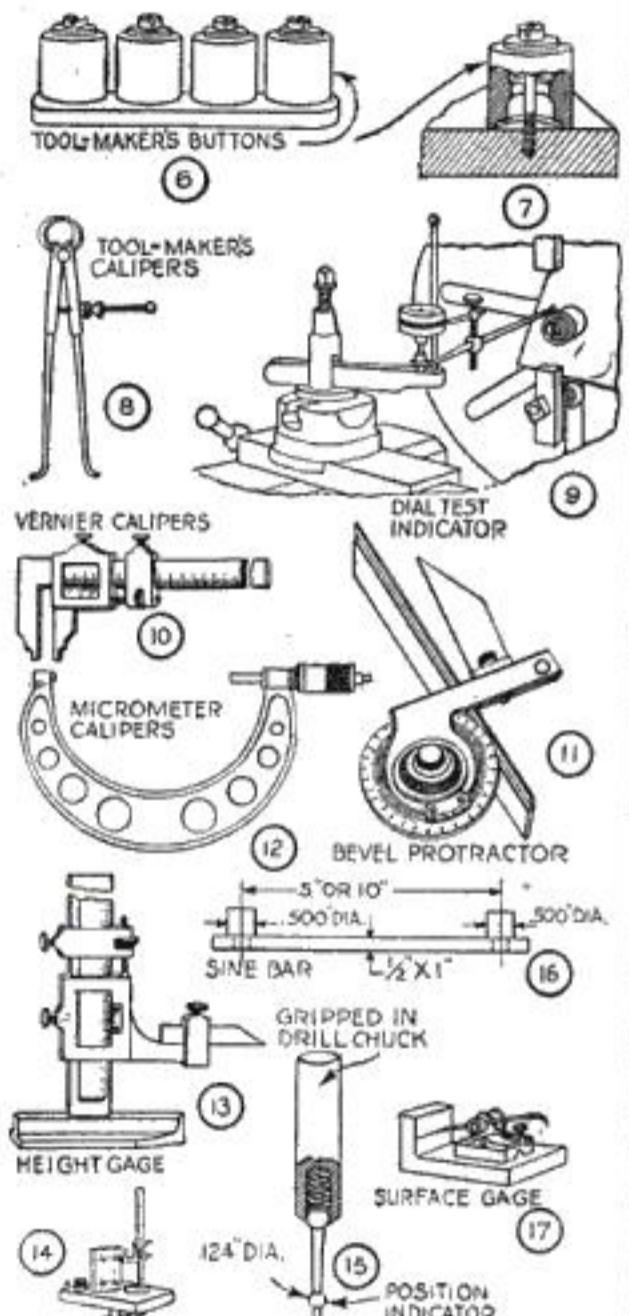
Locating Holes in Jigs and Dies

(Continued from page 100)

and noting the divisions on the dial indicator at the end of the screw.

To get the next hole position, the machine table has to move 5 in. If the screw has four threads to the inch, one revolution will move the table $\frac{1}{4}$ in. Therefore we must make four turns for 1 in. or 20 turns altogether. Set the dial at zero and give the screw 20 turns, bringing it to a stop on the last turn at the zero mark. Lock the table and proceed as for the first hole. For hole No. 3 move the machine table at a right angle to the first line of movement with the cross-feed screw. Hole No. 4 is located by reversing the direction.

Where extreme precision is required, the workman should test the accuracy of



Methods of making measurements and some of the tools used in laying out jigs and dies

the feed-screws before using them to locate positions, as long usage wears the screw in certain places more than others. This can be done with some kind of dial test indicator. Fix the indicator to the machine spindle and the contact point against a fixed point on the table. Now move the table in one direction and note the comparison of the indicator and the screw dial. Test it in this way for several inches.

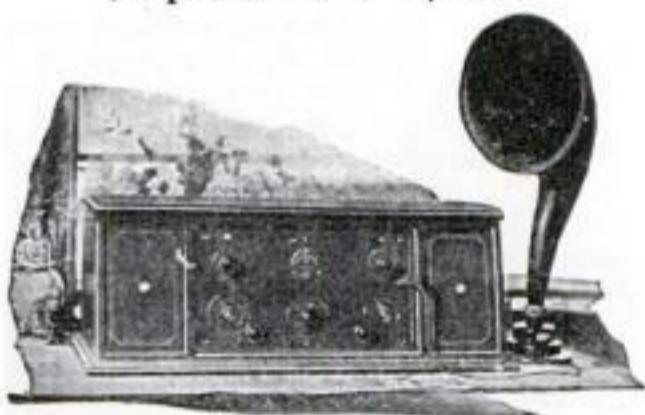
If the screw is found to be inaccurate, the error must be compensated when using it to lay off distances that must be right. Find the amount of the error and allow

(Continued on page 110)



The family takes to politics

Radiola Regenoflex
Non radiating! It cannot interfere with your neighbor's reception. With four Radiotrons WD-11 and Radiola Loudspeaker. With compartments for the batteries. Complete except batteries. . . \$191.00



This symbol of quality  is your protection

Send for the free booklet that describes every Radiola

RADIO CORPORATION OF AMERICA
Dept. 1011 (Address Office Nearest You)
Please send me your Radio Booklet, and the name
of the nearest RCA distributor.

Was a time when we voted Pa's ticket 'cause he did and his Pa did. When most of us couldn't get much closer to a candidate and his ideas than the soap box orator on the corner. When bonfires and torchlight parades were as exciting a part of election day as the candidates and issues. Politics was no place for ladies, and what little the women knew about it they gleaned from scraps of the men folks' talk.

Radio has changed it all. Every farm—every city living room—every corner radio store will be a gathering place for the people, listening in. There'll be a Radiola Regenoflex on the farm, where distance demands a sensitive receiver. There'll be a Radiola Regenoflex in the city home, where selectivity is most important—to tune out conflicting stations. You'll find one wherever good, clear, dependable loudspeaker reception is bringing the candidates and the issues right into the home—building America into a real democracy.

"There's a Radiola for every purse"

Radio Corporation of America

Sales Offices:

233 Broadway, New York

10 So. La Salle Street, Chicago, Ill.

433 California Street, San Francisco, Cal.

Radiola

REG. U. S. PAT. OFF.



Famous scientists of sound achieve New Radio Triumph

Have you ever noticed how often a baritone solo sounds like a bass in a loud speaker concert? How a violin will sound like a cello? How a soprano will deepen into a mezzo or a contralto?

There is an easily understood reason for this. Sound, passing through a funnel, tends to lower its register. Speak through a megaphone and see how much lower your voice sounds.

Radio engineers have recognized this loud speaker problem—but it remained for the famous Dictograph sound-scientists to solve it.

Into the problem they put their 20 years' experience in the making of sensitive sound instruments—the Acousticon for the deaf; the Detective Dictograph and the loud speaking Interior Telephone.

\$25.00



The Upright

Beautiful concert model, finished in attractive etched ebony. Easily hooked in on any set without extra batteries.

\$25.00

Detective Dictograph and the loud speaking Interior Telephone.

Out of three years continuous experiment came the Dictogrand Loud Speaker—the new type loud speaker based on principles

Dictogrand

The Articulating True Tone
LOUD SPEAKER

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DICTOGRAPH PRODUCTS CORPORATION

220 W. 42nd St., New York City, Dept LII

Please tell me how to secure a Dictogrand on five days free trial. Also send "Applause Cards."

Name.....

Address.....

Radio Dealer's Name.....

Locating Holes in Jigs and Dies

(Continued from page 108)

this on the dial indicator of the screw in moving from one point to another.

Another way to overcome an error in the feed-screw is to measure the movement of the table with a Vernier caliper or micrometer from some fixed point on the machine table to the center of the spindle. A simple way to do this is insert a size plug in the first hole bored, move the table, measuring with the feed-screw to the next point, then measure the distance from the plug in the first hole to a plug that fits the taper hole in the spindle.

When there is no convenient point of known accuracy to start from in laying off holes in the jig, one button can be located in the position of the first hole and all other locations can be measured from the button. After the first hole, use a size plug in it instead of the button.

When laying off or measuring distances with the feed-screws, they must be rotated in one direction only.

Bushing holes can be bored in the drill press when precision measurements are not required. Positions are laid out with a surface gage or dividers, as in Fig. 17. The points are center-punched lightly with a sharp punch. Use the position indicator in the drill chuck the same as directed for the milling-machine method. When the ball of the indicator is running true, adjust the table until the point will bear in each center punch mark in turn. Then drill and bore the holes with an adjustable boring head.

THERE are several other well known methods of locating and boring holes, but the two I have described here illustrate the fundamental principles.

If the young toolmaker is well grounded in the principles of the work, he need have no apprehension about quickly learning and using new methods.

Holes in dies and experimental work can be located and bored by practically the same methods.

In laying out angles on work requiring great accuracy, the Vernier bevel protractor (Fig. 11) is an essential. The accuracy of the best protractor, however, is limited to 1/12 of 1 deg. or 5 min. Where closer angle measurements must be taken it will be necessary to use the sine bar shown in Fig. 16. This is in itself a simple tool, but should be very carefully made. It consists of a tool-steel bar hardened and ground, all sides absolutely parallel. Two tool-steel plugs, carefully ground for size, are fitted to the bar. The center distance between plugs should be an even dimension—5 or 10 in. is recommended—to simplify calculations.

The use of this tool requires a knowledge of trigonometry. The bar is clamped to the face of a special angle plate, which should rest on an accurate surface plate. The plugs are then set with a Vernier height gage or size blocks to a height from the true horizontal to correspond with known dimensions of the required angle. This angle then can be transferred to the work by setting the bevel protractor to the sine bar. Any division of an angle in degrees, minutes, and seconds can be obtained with this tool.

EVEREADY Radio Batteries

-they last longer



EVEREADY RADIO BATTERIES FOR EVERY RADIO USE

Each one supremely economical and efficient for the use for which it is designed—each one made under the supervision of the world's greatest electro-chemical battery laboratory

Eveready "B" Batteries

THERE are Eveready Batteries for portable sets where small size and light weight are more important than long life. There are Eveready medium size batteries that come between the small and the standard size. There are Eveready large size "B" Batteries that afford maximum economy and reliability of service when used with average one, two, three or four tube sets. And now there is a newer Eveready heavy duty, extra large size "B" Battery that gives similar economy to owners of

multi-tube heavy drain sets and power amplifiers.

For maximum "B" Battery economy, buy Evereadys, choosing the large sizes (Nos. 766, 767, 772) for average home sets, and the heavy duty, extra large (No. 770) for multi-tube heavy drain receiving sets and power amplifiers. For portable sets choose the Eveready No. 764 medium size, unless space is very limited, in which case choose the Eveready No. 763 small size "B" Battery.

Eveready "C" Battery

Eveready makes a long-lasting

"C" Battery with terminals at $1\frac{1}{2}$, 3 and $4\frac{1}{2}$ volts. May also be used as an "A" Battery in portable sets.

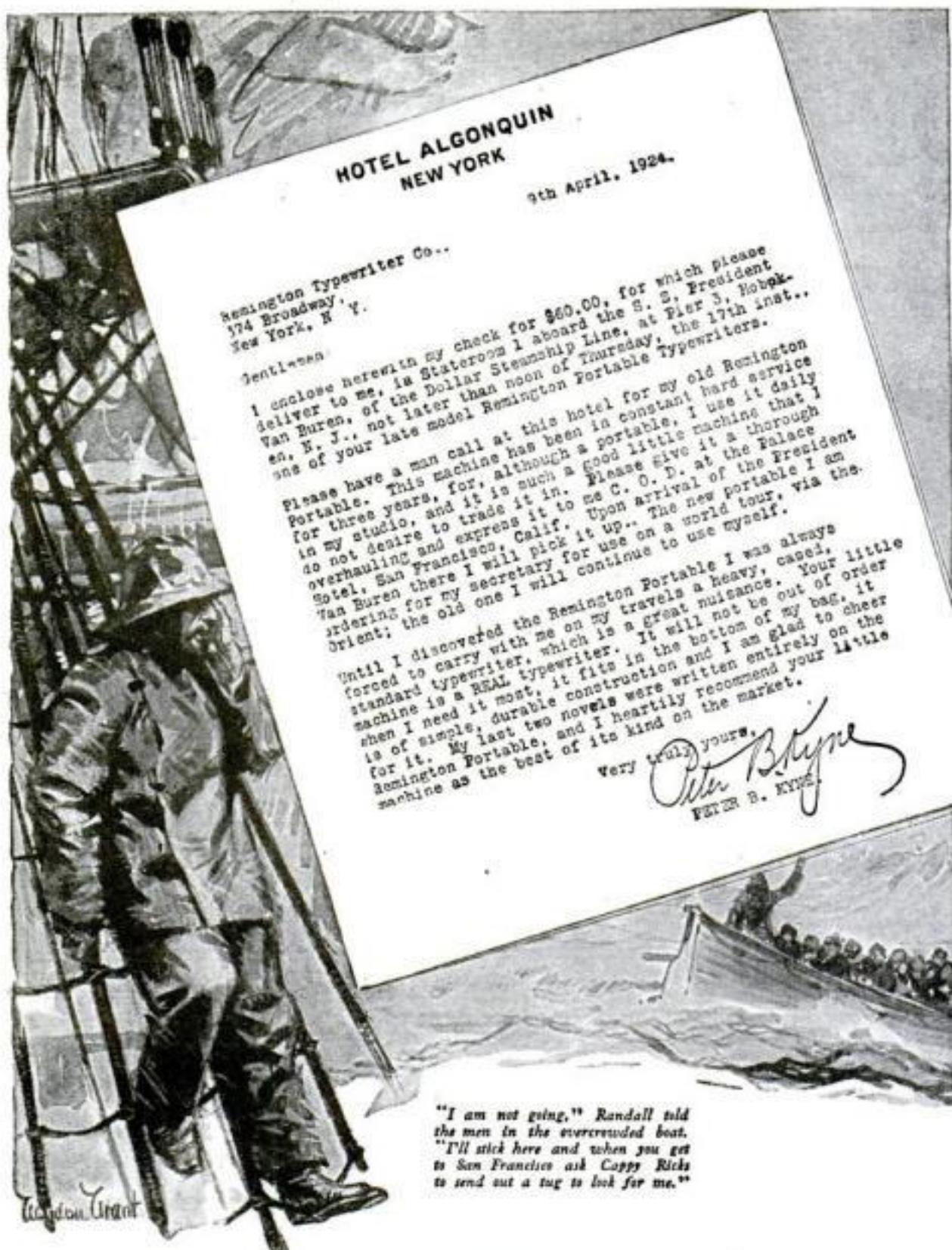
Eveready "A" Batteries

Eveready offers you "A" Batteries for all tubes, both storage and dry cell. For storage battery tubes, use the Eveready Storage "A." For dry cell tubes, use the Eveready Dry Cell Radio "A" Battery, especially built for radio use only.

Manufactured and guaranteed by
NATIONAL CARBON CO., INC.
Headquarters for Radio Battery Information
New York San Francisco
Canadian National Carbon Co., Limited, Toronto, Ont.

BUY THEM FROM YOUR

DEALER



"IT'S A REAL TYPEWRITER"

The Remington Portable has won the endorsement of Peter B. Kyne, just as it has won the endorsement of prominent people the world over—by its outstanding superiority. Its success has been phenomenal.

Many present owners, like Mr. Kyne, have operated other typewriters. In the Remington Portable they have found a compact machine which meets every requirement, built to do beautiful work, and possessing every feature common to the big machine, even to the four-row standard keyboard.

Why should you continue to write in the old-fashioned, slow, tedious, long-hand, when with a Remington Portable you can turn out a beautifully clear and legible printed page, with far less time and effort? It's time to buy a Remington Portable. Sold by all Remington branches, and over 5,000 dealers. Easy terms.

Illustrated "For You—For Everybody" will be sent upon request. Address Department 67.

REMINGTON TYPEWRITER COMPANY

374 Broadway, New York

Remington Typewriter Company of Canada, Limited
Main Office, 68 King Street West, Toronto



REMINGTON Portable Typewriter

THE RECOGNIZED LEADER—IN SALES AND POPULARITY

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

Inexpensive Micrometer Set Has Range of from 6 to 24 Inches

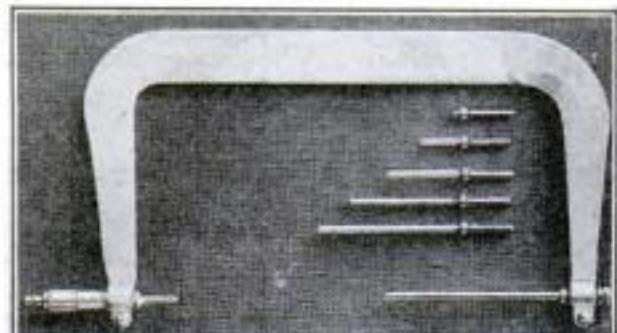
By Edwin Kilburn

MODERN machine work and automobile repairing require the use of accurate measuring instruments, particularly micrometers, for the production of satisfactory work. The expense of a complete set of micrometer calipers, covering all the sizes encountered in machine work and motor servicing, is usually prohibitive in the small shop, and consequently makeshift methods are used, with unsatisfactory results.

The writer designed and made for his own use a set of outside micrometer calipers, measuring from 6 to 24 in., at a moderate cost, considering the efficient service obtained from them.

Briefly, the system followed in constructing this set is that of using a standard micrometer head in connection with such frames as will cover the range of measurements desired. Each frame has a measuring capacity of 6 in., each inch of range being taken care of by means of removable anvils.

The accompanying photographic reproduction shows the appearance of the



A frame with standard micrometer head and anvils for measuring from 6 to 12 inches

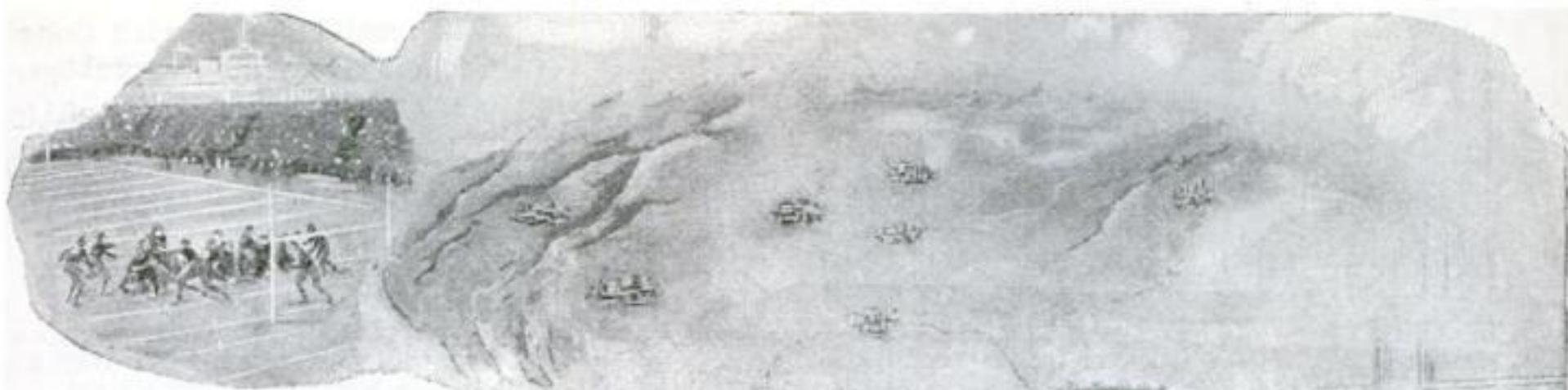
6 to 12 in. frame, anvils, and micrometer head.

The frames are constructed as follows: A piece of cold rolled steel, 5/16 by 1 1/2 in., is cut to the proper length and bent at two points to form the frame. The round bodies at the ends of the frame are made of steel shafting welded to the flat steel. The clamping lugs on the round bodies are made by welding mild steel pieces to the round steel bodies, as shown; these clamping lugs are for the purpose of securing the micrometer head and the frame adjusting sleeve in position for use.

The frame adjusting sleeve just mentioned requires an explanation to make its use clear. Most mechanics are familiar with the type of micrometer using a fixed micrometer head and removable anvils, each anvil having an adjustment to permit its being brought to standard adjustment. This type of micrometer is a very useful tool and the one we constructed is an adaptation of the same idea with the addition of the use of an adjusting sleeve in each frame, this sleeve being adapted to receive the anvils instead of their being mounted directly in the solid frame end, as in the older type of construction.

We also use an individual adjustment on each anvil, the idea of this duplicate adjustment being that when one set of anvils is adjusted properly in one frame, any anvil may be used in any other frame

(Continued on page 114)



Thrill With the Big Crowd

FOR real thrills, tense moments and dramatic situations, what can compare with a football game between two great American colleges?

A crisp fall day, stands jammed to the bursting point, bands playing, college songs and cheers, stirring the very souls of spectator and player alike—what could present a more inspiring, colorful picture?

You may not see the game, but with MUSIC MASTER attached to your radio set you can, in the comfort of your home, follow your favorite team up and down the field. The vivid word-picture of the announcer, play by play, will reach you with bell-like clarity through this wonder instrument of radio.

Until you hear the voice of MUSIC MASTER you have not heard radio at its best. Your dealer will send one to your home to prove with your own set.

Get a MUSIC MASTER and have it ready for the next game.

Dealers Everywhere

MUSIC MASTER CORPORATION

Makers and Distributors of High-Grade Radio Apparatus

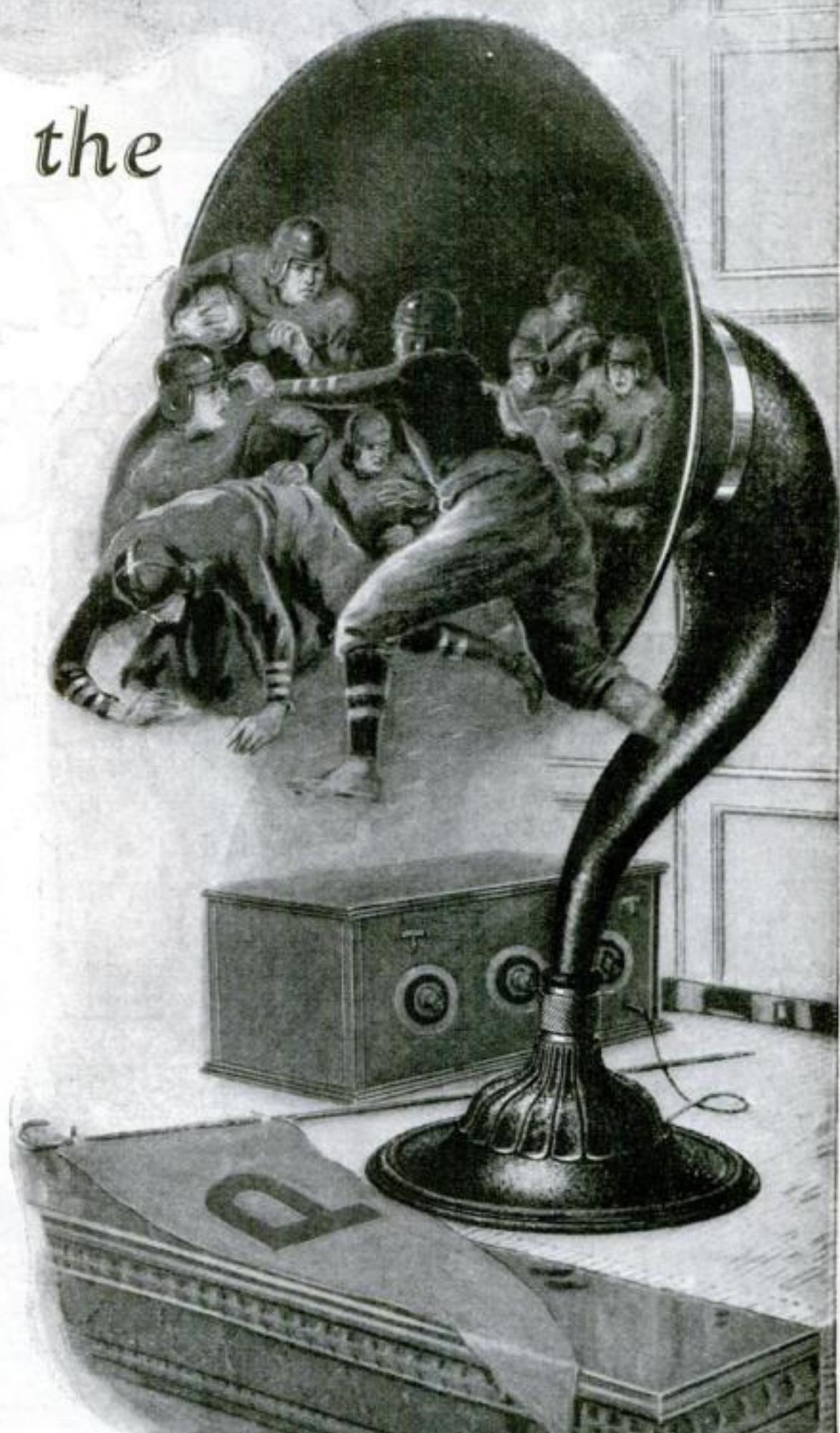
10th and Cherry Streets

Chicago

PHILADELPHIA

Pittsburgh

music master
RADIO REPRODUCER

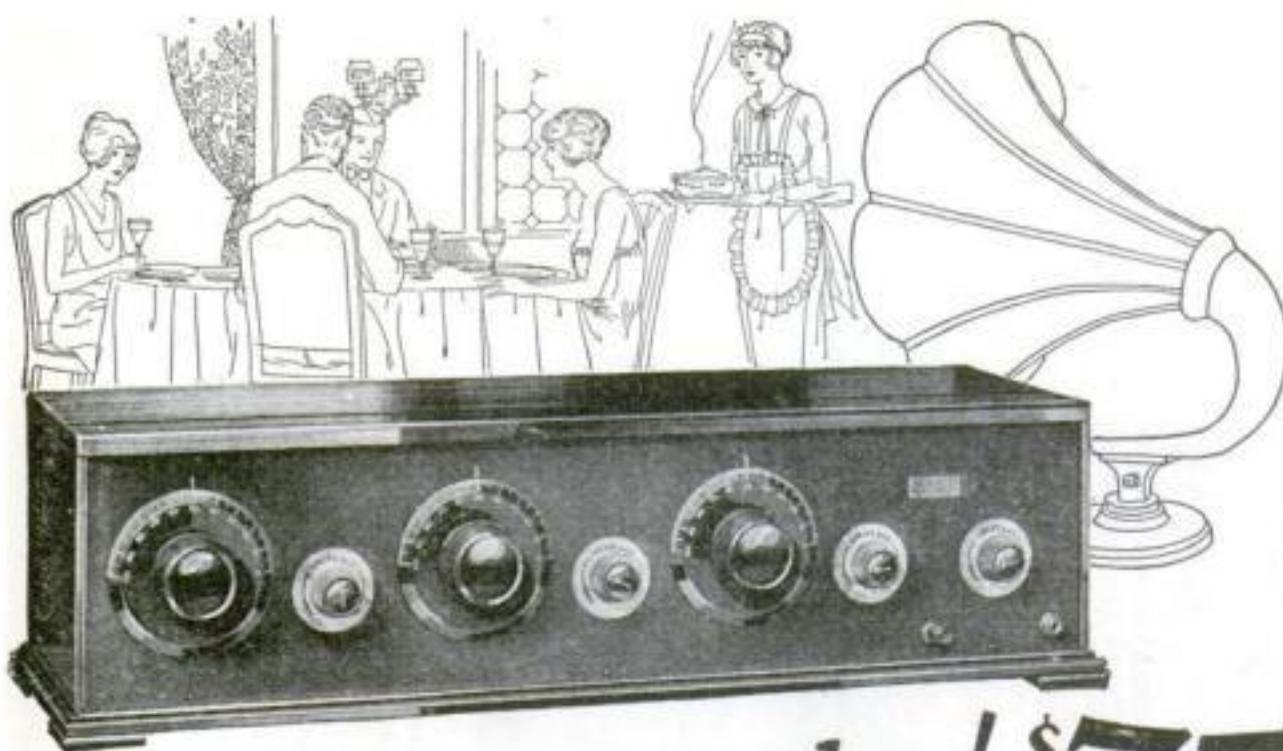


Connect MUSIC MASTER
in place of headphones.

No batteries required.
No adjustments.

14-inch Model, for \$ 30
the Home

21-inch Model, for \$ 35
Concerts and Dancing



"Coast to Coast"
reception verified
by Miraco users

Note: Miraco sets, built by pioneer set manufacturers, embody improvements, refinements and features used in the most costly sets. Every Miraco user is an enthusiastic booster.

Ohio Hears California

I will compare my Miraco to any set I have ever heard. Received many distant stations, such as CFCK, KPO, PWX and KGO, Oakland, Calif. Am listening to WHAZ now.—E. M. Reister, College Corner, Ohio.

Virginia Hears Pulman, Wash.

In one day I received on my Miraco, St. Louis, Minneapolis and Pulman, Washington.—J. C. Ashley, Portsmouth, Va.

42 Stations in 8 Nights

In eight nights I have heard 42 stations on my Miraco over a phonograph attachment.—Earl Sheldon, Morgantown, W. Va.

Tennessee Gets Coast to Coast

My Miraco set works finely, picks up stations from Coast to Coast. Am well pleased.—W. T. Tacker, Adamsville, Tenn.

No. Dakota Hears Cuba

My Miraco works fine. Have heard from coast to coast, also many stations in Canada and Havana, Cuba.—T. G. Anderson, Turtle Lake, N. D.

and now! \$75
List

The Marvelous **MIRACO** Ultra 5

FIVE TUBE OUTFIT

Send
for
Bulletin
Today!

BUILT for loud speaker reception from stations thousands of miles distant, through local interference; composed of the finest parts; encased in a beautiful hand rubbed solid mahogany cabinet; and fully guaranteed. At \$75 the Miraco "Ultra 5" offers unquestionably the most astounding value the radio world has ever known.

*Unsurpassed selectivity, sensitivity,
range, volume and tone combined.*

Non-radiating, non-howling, non-distorting, easily tuned and logged. Equipped with filament switch, phone jack, bakelite panel, bakelite sub-base under which all wiring is concealed, and other latest refinements. Two stages tuned radio frequency amplification, detector and two stages audio frequency amplification.

Other Miraco Long Distance Sets \$14³⁵ up

Send for proof they are one of the finest low priced radio receivers. Tested and approved by highest radio authorities. One-tube outfit, \$14.35. 3-tube loud speaker outfit, \$29.50. 4-tube loud speaker outfit, solid mahogany cabinet, \$54.50. All sets completely assembled, factory-made, factory-tested and factory-guaranteed. Send coupon now for latest bulletins, and testimony of users proving coast to coast reception.

DEALERS — JOBBERS AGENTS

Miraco's wonderful tone, distance-getting ability and low prices makes them easy to sell. Send coupon for proposition; good territory open.

MIDWEST RADIO CORPORATION
408 East Eighth Street, Cincinnati, Ohio.

Send free literature and particulars of your complete line of Miraco products.

() Dealer
() Agent

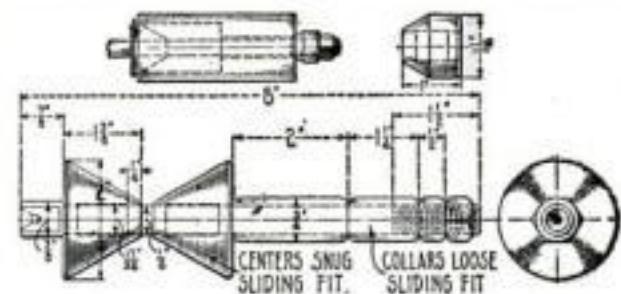
() Jobber
() User

Please print name and address on margin below.

Universal Mandrel with Cone Centers Has Wide Adaptability

AN ADJUSTABLE mandrel useful for work that must be turned on centers and does not require a high degree of accuracy, is shown in the accompanying illustration. This tool does away with the necessity of turning up an endless number of temporary mandrels for odd-sized and odd-shaped holes, for which it is not possible to use standard mandrels or even expanding mandrels, if they are available, which often they are not.

One advantage of this contrivance is its great range of adaptability; another is its simplicity and the comparative ease with which it can be made. It consists of a spindle formed with centers having a threaded portion at one end and a small shoulder at the opposite end, and two



Adjustable mandrel showing dimensions that have proved useful, and extra small cone center

cone-shaped, sliding centers. A series of four spacing collars of different lengths enable the tool to be quickly adjusted to any desired length within its range.

The range of the device can be increased greatly by providing a set of smaller as well as the larger cone centers. The two sizes allow work large at one end and small at the other to be held. A smaller cone is also useful where a large center might be in the way of the tools.

It is desirable, although not absolutely necessary, to harden the several parts. The spindle may be made from drill-rod, or, better yet, from some non-shrinking tool steel. The centers, at all events, should be made from tool steel and hardened, lapped on the inside, and ground and stoned on the faces, in order to retain their accuracy. The spacers are made from cold-rolled steel, and may be case-hardened.—S.

Inexpensive Micrometer Set

(Continued from page 112)

of the set if the frame is standardized to the anvil by use of the adjustable sleeve, so it is necessary only to set one of the standardized anvils in any frame but the one it was first set in, to bring the whole set to standard in that frame.

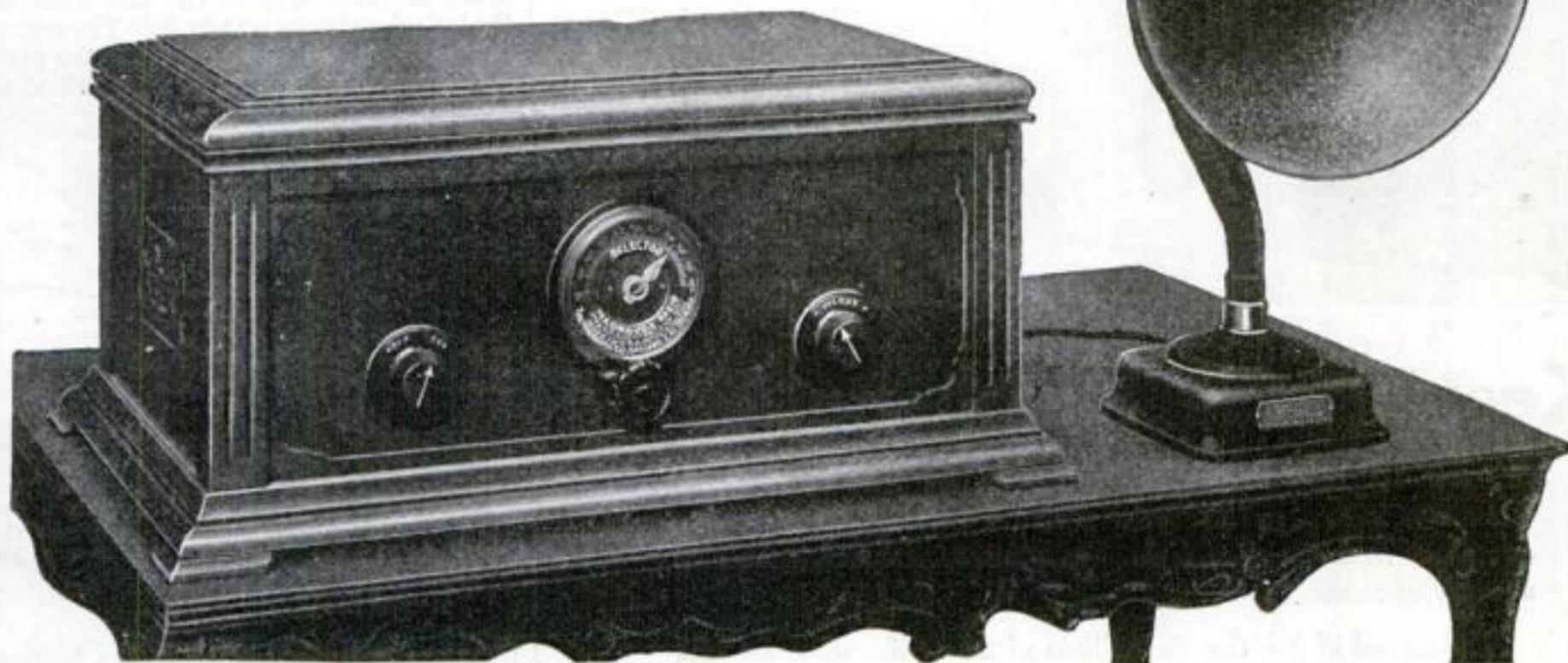
This greatly simplifies the set, as we use only six anvils for the whole range of 6 to 24 in., and by making another frame measuring from 0 to 6 in. we could cover the 24 in. with the one set of anvils, four frames and one micrometer head.

The essential parts at the anvil end are the anvil, the anvil locknut, the anvil adjusting nuts, and the frame adjusting sleeve. The anvils are flattened at the threaded end on one side and a key is provided in the threaded adjusting sleeve to keep them from rotating.

Drill rod is used for the anvils, and steel shafting or screw stock for the other machined portions of the set.

MAGNAVOX Radio

BROADCAST RECEIVER



The new Magnavox TRF-5 Receiver is here shown with Magnavox M4 Reproducer, (\$25.00) which insures clearest tone.

The long awaited Broadcast Receiver

Combining supreme efficiency, convenience and beauty, produced at a low cost which brings it within reach of all.

HERE at last is the perfected instrument permitting you to enjoy simultaneously the most desirable elements of broadcast reception—features which no one model ever combined before.

The distinctive Magnavox tuned radio frequency circuit is characterized by exceptional clearness and volume as well as selectivity. The Magnavox Unit Tuner does away with all complicated dialing and places the novice on the same footing as the radio expert.

Magnavox Broadcast Receivers and other Magnavox Radio Products are sold by reliable dealers everywhere. Write for new illustrated catalog.

THE MAGNAVOX CO., Oakland, Calif.

New York: 350 West 31st Street San Francisco: 274 Brannan Street
Canadian Distributors: Perkins Electric Limited, Toronto, Montreal, Winnipeg



TRF-5

A 5-tube tuned radio frequency receiver consisting of two stages of tuned radio frequency of special design, detector and two stages of audio frequency.

Cabinet measures: height, 9½ in.; length, 20½ in.; depth, 14¾ in.

Without tubes, batteries or reproducer \$125.00



TRF-50

This model is identical with TRF-5 but encased in larger carved cabinet with built-in Magnavox Reproducer.

Handsome carved cabinet measures: height, 14¾ in.; length, 20½ in.; depth, 18¾ in.

Without tubes or batteries \$150.00



Keeping the Telephone Alive

Americans have learned to depend on the telephone, in fair weather or in foul, for the usual affairs of the day or for the dire emergency in the dead of night. Its continuous service is taken as a matter of course.

The marvel of it is that the millions of thread-like wires are kept alive and ready to vibrate at one's slightest breath. A few drops of water in a cable, a faulty connection in the wire maze of a switchboard, a violent sleet, rain or wind storm or the mere falling of a branch will often jeopardize the service.

Every channel for the speech currents must be kept electrically intact. The task is as endless as housekeeping. Inspection of apparatus, equipment and all parts of the plant is going on all the time. Wire chiefs at "test boards" locate trouble on the wires though miles away. Repairmen, the "trouble hunters," are at work constantly wherever they are needed in city streets, country roads or in the seldom-trodden trails of the wilderness.

Providing telephone service for this great nation is a huge undertaking. To keep this vast mechanism always electrically alive and dependable is the unending task of tens of thousands of skillful men and women in every state in the Union.



**AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES**

BELL SYSTEM

One Policy, One System, Universal Service



MAKE BIG MONEY CHARGING BATTERIES

You can easily make \$150 to \$300 clear profit every month with HB 8 Hour Battery Charging. Small payment brings complete outfit. Your profits easily pay small monthly terms. 30 days' trial, money-back guarantee. Best season just starting. Write today for free Bulletin 118.

HOBART BROS. CO.
Box P11

Football for Everybody

Every fan, old or young, likes The Gregg Football Game. A scientific representation of college football for use indoors. Not a toy using spinners, cards or dice, but a new game of wits and strategy played on a table with a small football field and two teams. Each player is his own Quarterback and directs his team as in real football. At your sporting goods dealer or postpaid for \$2.50. C. O. D. 10c additional.

ALBERT A. GREGG CO., Dept. S, WEST JEFFERSON, O.



Tool Cases

for Machinists, Carpenters and Tool Makers; none better; thirty styles. Quartered oak and metal covered. Ask for booklet. "Built for Service"

The Pilled Lumber Co., Swanton, Ohio



For You--Mr. Sign Painter

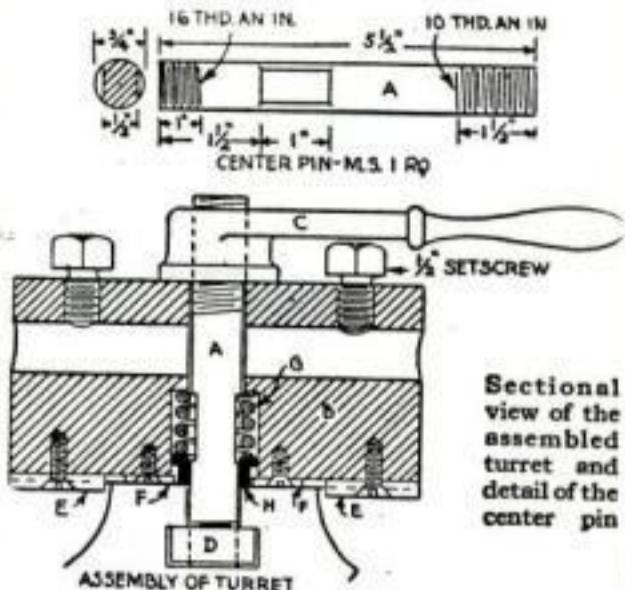
It's the very newest and latest help for Sign Painters and Showcard Writers. Letter Patterns. Helps the inexperienced and aids the finished expert. Turn out neat signs in less than one-half the usual time. Make Sign Painting and Showcard Writing as easy as A, B, C. Samples for stamp. JOHN F. RAHN, D-2433 GREENVIEW AVENUE, CHICAGO, ILL.

Turret for Small Lathe Built on Simple Lines

By Frank N. Coakley

ONE of the handiest lathe attachments the owner of a small machine shop can provide for himself is a turret head. The one shown is simple in construction and will be found quite efficient.

When in operation, the turret *B* is held firmly in place against the tool block of the lathe by the center pin *A*. The movement of the turret is gaged by the steel blocks *E*, which are set in slots milled at

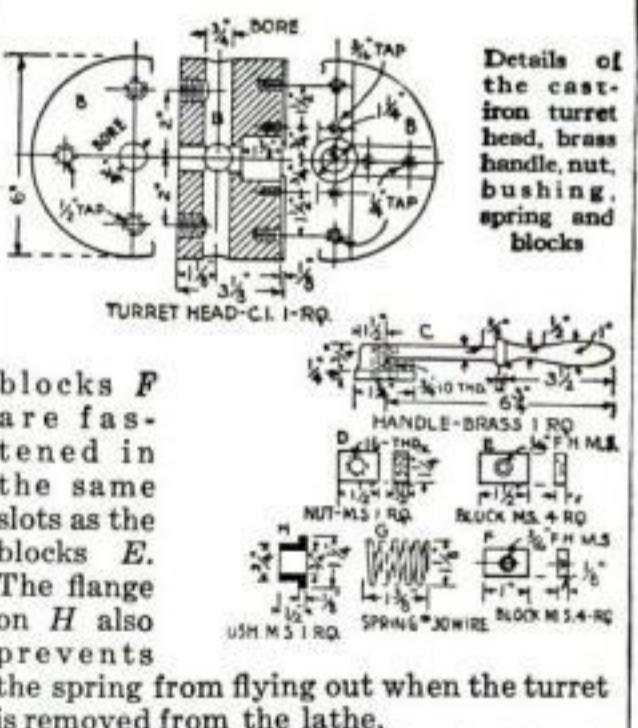


Sectional view of the assembled turret and detail of the center pin

right angles to each other at the bottom of the turret. These blocks, which project below the turret, are made a snug fit in the slot of the tool block. It is advisable to harden these blocks.

In operation, the turret is rotated by loosening the handle *C*, which allows the spring *G* to raise the turret until the blocks *E* clear the toolpost casting. The turret then may be swung to the desired position and clamped in place with the blocks *E* in the toolpost slots.

The collar *H* prevents the spring *G* from moving the turret too far, as the flange of the collar stops against blocks *F* when the handle *C* is released. The

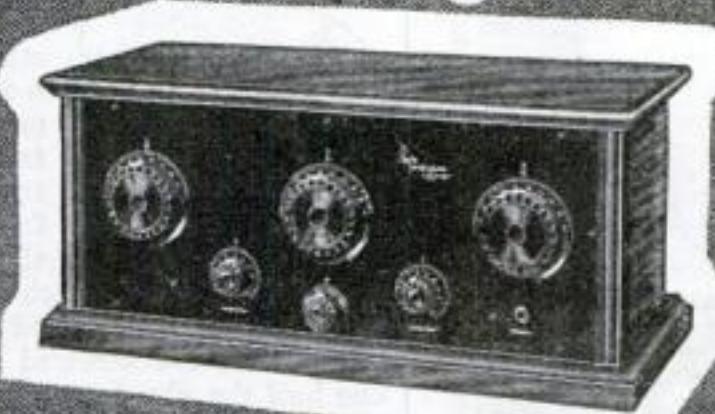


blocks *F* are fastened in the same slots as the blocks *E*. The flange on *H* also prevents the spring from flying out when the turret is removed from the lathe.

The center pin is threaded on both ends and flattened as shown in the detail. The end for the nut *D* has a finer thread than the end for the clamping handle *C*. The pin is slipped into place and screwed tightly through the nut *D*, so as to bind it firmly in place. This enables the operator to use a stop on the lathe bed in

(Continued on page 118)

The GREATER Neutrodyne



New Model B **EAGLE**

Balanced Receiver

A WONDERFUL circuit made greater by epochal refinements. The NEW *Model B* Receiver enormously emphasizes the outstanding dominance of the *EAGLE Balanced Neutrodyne*.

Every Vital Part Manufactured In the EAGLE Factory

Every instrument that must carry any responsibility for the efficiency of the EAGLE Model B Receiver is made in the EAGLE factory under the supervision of EAGLE engineers.

EAGLE Instruments ONLY in EAGLE Receivers

The vastly improved instruments described in the adjoining panel **CANNOT BE PURCHASED ANYWHERE AT ANY PRICE** except as incorporated in the New Model B EAGLE Receiver. Developed explicitly for the Eagle Model B.

INSIST Upon These Advantages

You want the very latest improvements in your radio set. Then you want these **Advantages**—multiple switch, ball-bearing die-cast condensers, and the recently developed, revolving resistor element rheostat.

Price \$175.00

Licensed by Independent Radio Manufacturers, Inc., under Hazeltine Patent Nos. 1,450,080, dated March 27, 1923, and 1,489,228, dated April 1, 1924. Other patents pending.

EAGLE



Radio Co.

26 BOYDEN PLACE, NEWARK, N. J.



MODEL BS
A NEW EAGLE ARTISTIC
CONSOLE CABINET

Price \$100

An artistic Console cabinet, for the EAGLE, in American Walnut or Mahogany, with fume-proof compartments for battery and charger. Ask our dealer to show you this beautiful installation.



GET a Year's
GUARANTEE
on the next Set
YOU BUY—

The EAGLE
Warranted
for ONE YEAR

Because
Ball-Bearing
Die-Cast
CONDENSERS

An entirely new departure in condensers. Both rotor bearings are ball-bearing. Rotor and stator plates are die-cast integral with their support.

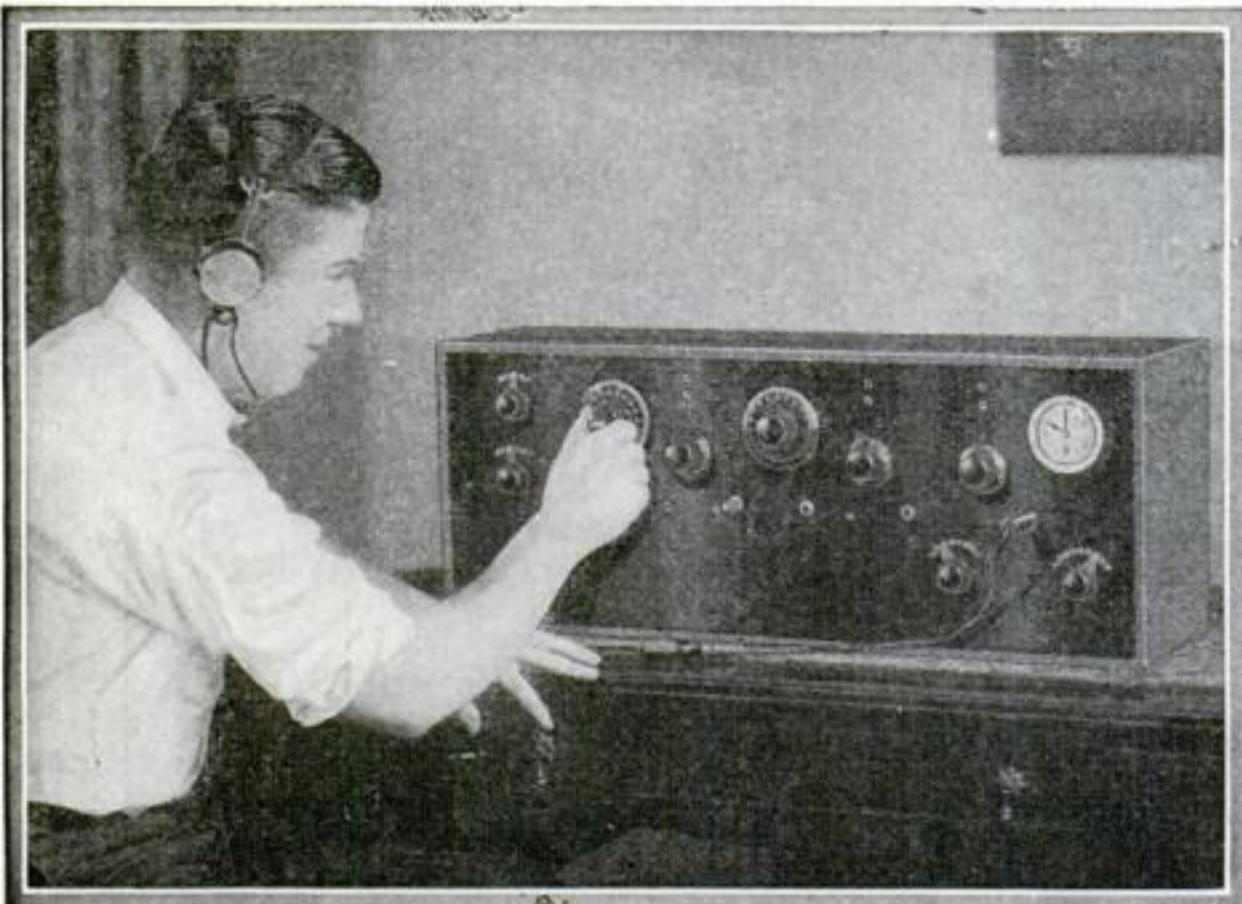
Revolving Resistor RHEOSTAT

The resistor element, instead of the contact, is the operating unit in the EAGLE rheostat.

EAGLE Multiple Switch

Instead of several jacks, which are inherently weak, a smoothly operating *multiple* (filament control) switch controls all battery connections.





With the clock in his panel Mr. Kent checks time with the Government signals from Arlington and keeps track of broadcasting schedules. Note the beautiful finish of the Celoron panel.

What Kent says about panels

Albert Kent builds his own sets. He uses instruments of the highest quality. He has found that it does not pay to mount his parts on just any old radio panel. He writes:

"Having completed over thirty radio receivers of various styles, I thought you would like to know of the truly wonderful results obtained with the use of Celoron panels.

"By the process of elimination, I found that Celoron was the only satisfactory panel, mainly because of its extremely low loss of high frequency currents. This characteristic brings in distant stations clearly with a simple hook-up. I find working with Celoron a pleasant task and every completed receiver makes a

strikingly beautiful appearance. The first one, after three years' hard use, still looks like new.

"I wish I could tell every experimenter to begin building his set in the right way by using the best obtainable panel—and that is Celoron."

Send for Free Booklet

For set builders we have a special free booklet, "Getting the Right Hook-Up with Celoron." It contains valuable hints for set builders. Write to Department 4 A for your copy.

CELORON A BAKELITE PANEL

Diamond State Fibre Company Bridgeport Pa., and Chicago, Ill.

Branches in Principal Cities

Toronto, Canada—London, England

How to Make and Use a Small Chemical Laboratory

By Raymond Francis Yates. The treatise covers all of the essentials of elementary chemistry. The second part of the book is devoted to chemical and electro-chemical experiments. Price, 75 cents

Popular Science Monthly
250 Fourth Avenue New York

Electric Bells

A complete treatise for the practical worker in installing, operating and testing bell circuits, burglar alarms, thermostats and other apparatus used with electric bells. The detailed instructions for building the apparatus will appeal to the experimenter particularly.

124 pp. Fully illustrated Price, 75 cents

POPULAR SCIENCE MONTHLY
250 Fourth Avenue New York City, N. Y.

Sells for \$1.25. Agent's Sample 65c!



Imported from Japan. "It makes Carbon Copies." Guaranteed for 1 year. Hustlers Making \$20 Daily! Money refunded if you don't think it's the best pen you ever wrote with. Up to 150 per cent Profit. Send for quantity price list and distributing plans. F. SPORS & CO., 199 S. 4th St., Lesueur Center, Minnesota

New Self-Filling Bamboo Fountain Pen with Stylo Point

HAS EIGHT GROOVES FOR INK TO FEED

Fixture for Holding Studs

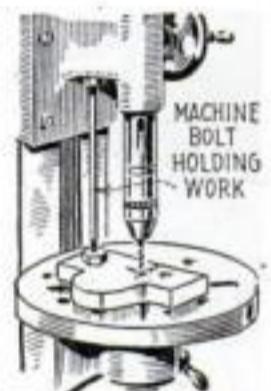
A QUICK-ACTING chuck for holding one threaded end of a stud while threading the other end can be made as shown from a piece of iron or steel. The piece is threaded through the center to receive the stud and then cut in two. These parts are drilled and tapped for three studs, which are to hold them together, and countersunk from inside to form pockets

that serve to spread them apart. Each of the three connecting studs are threaded on one end only. These ends are screwed and riveted in one half the chuck. The opposite ends serve as guides for the other half.

In use, this device is held in the lathe chuck. Then, to release a stud that has been finished, it is necessary merely to loosen the chuck jaws slightly in order to turn the stud out by hand. This does away with the necessity of using an alligator or pipe wrench.—G. T. SCHAEFER, Beardstown, Ill.

Single Rod Clamps Small Work on Drill-Press Table

A NOVEL method of holding work on the drill-press table without clamping it is illustrated. A bolt or any rod of the right length is placed between the work and the spindle brace of the machine. The table then is raised against the bolt with a little pressure; it will hold tightly enough to resist the torque of drills up to $\frac{1}{2}$ in. For repetition work on small drill presses this is a quick method.—H. W.



For repetition work

Turret for Small Lathe

(Continued from page 116)

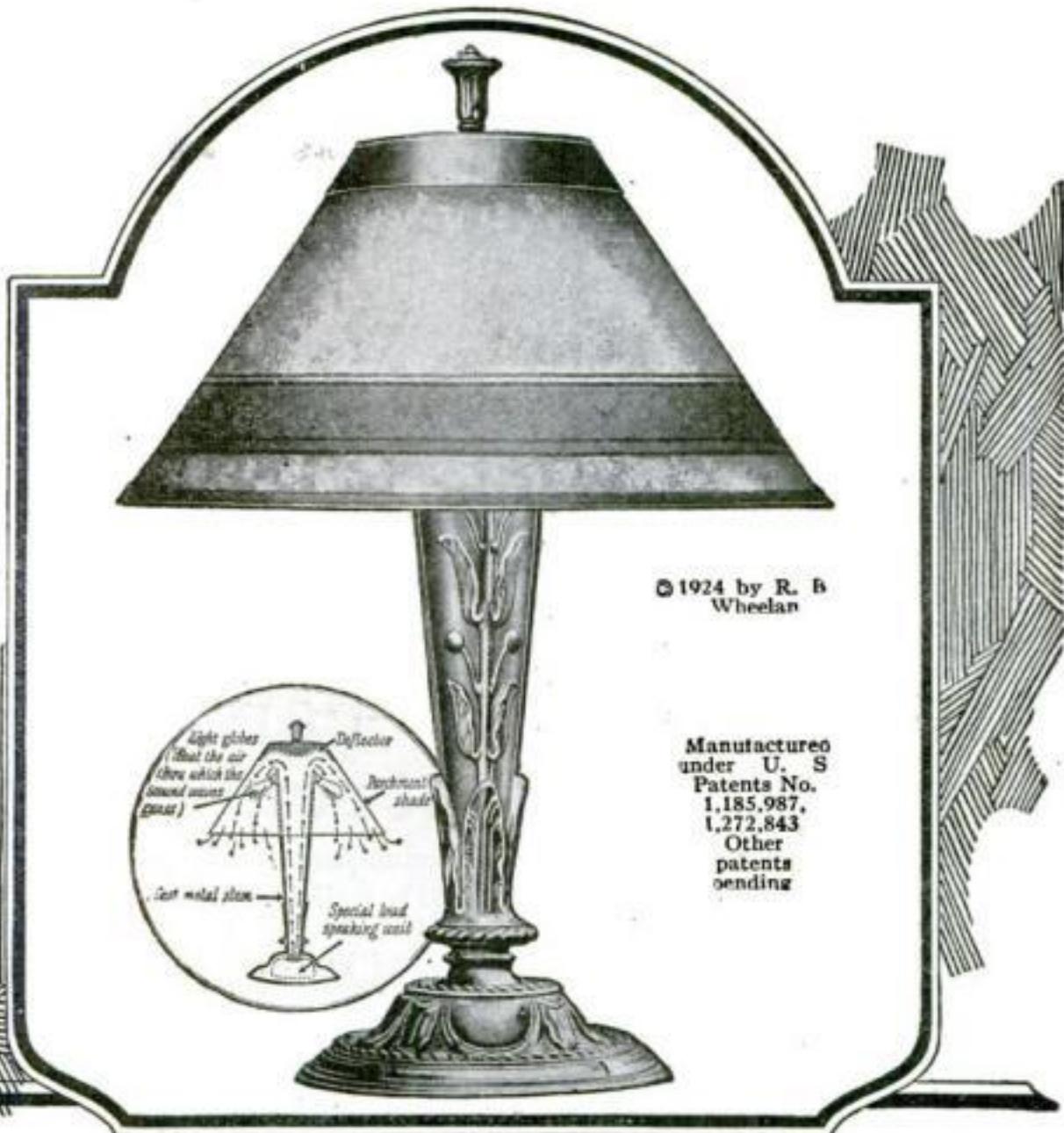
the production of duplicate parts, as the position of the pin is not affected by the movement of the handle C. The fine pitch of the lower thread prevents the pin from becoming loose when the turret is released.

Four holes are shown in the turret. It would be possible to use five or six, if the work is not too large. In making the head, the holes should be bored with the turret clamped in position on the lathe for which it is being made. A good plan is to use a boring bar on the centers. After the holes have been drilled, mark the cross slide, so that the turret can be reset in the proper place after it has been removed from the lathe.

If a larger turret is required than the one shown, the toolpost T-slot will govern the dimensions, which should be increased proportionately. The turret shown, however, is a husky one and will stand up under fairly heavy work.

**Soft, Mellow Light and
Clear, Natural Tone**

Simply attach the light cord of the *Radialamp* to any socket and switch on the light. The result is a soft, restful, mellow glow. Then attach the *Radialamp* to your receiving set—just as you would attach head phones. Instantly the room is flooded with music—amazingly clear, flawlessly natural—the most perfect tone reproduction known. *No extra batteries required—no adjustments to make.*



Art and Science Meet in This Amazing Radio Loud-Speaker

NOTHING in the history of Radio has created such a startling sensation as this amazing combination loud speaker and library table lamp.

It is not merely a *good* loud speaker. It is an infinitely *better* loud speaker. It is not merely a good looking table lamp. It is a thing of extraordinary artistic beauty—an object of pride in the finest homes.

Two Marvelous Features for Price of Either One

Comparison with ordinary horn, box or cabinet loud speakers instantly shows the vast superiority of the *Radialamp*. The sound is transmitted through a perfected unit concealed in the base of the lamp, and amplified through the tapered tone chamber to the "sound mirror" in the top of the shade. Here it is deflected through the warm air

surrounding the light globes into the taut parchment shade, whence it issues with a pure, flawless, human natural tone. The principle of sound reproduction here used is far in advance of anything ever before devised in the construction of loud speakers. And its soft mellow light and exquisite beauty of design gives it a rare value as a table or reading lamp.

By attaching a long wire to your receiving set, the *Radialamp* can be kept in another room if desired. And the cost is no more than you pay for either a loud speaker or lamp bought separately.

But you can't realize how remarkably and beautifully these two great features have been combined in one until you *see* and *hear* the *Radialamp* for yourself. Ask for a demonstration at your dealer's today. You have a delightful treat in store for you. Or if your dealer hasn't it, just fill in and mail the coupon. It will bring you complete information.

RADIOLAMP COMPANY

Dept. 211

334 Fifth Avenue

New York

ON SALE AT LEADING RADIO STORES EVERYWHERE

RADIOLAMP

TRADE MARK

• LOUD SPEAKER

(S) This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

RADIOLAMP COMPANY,

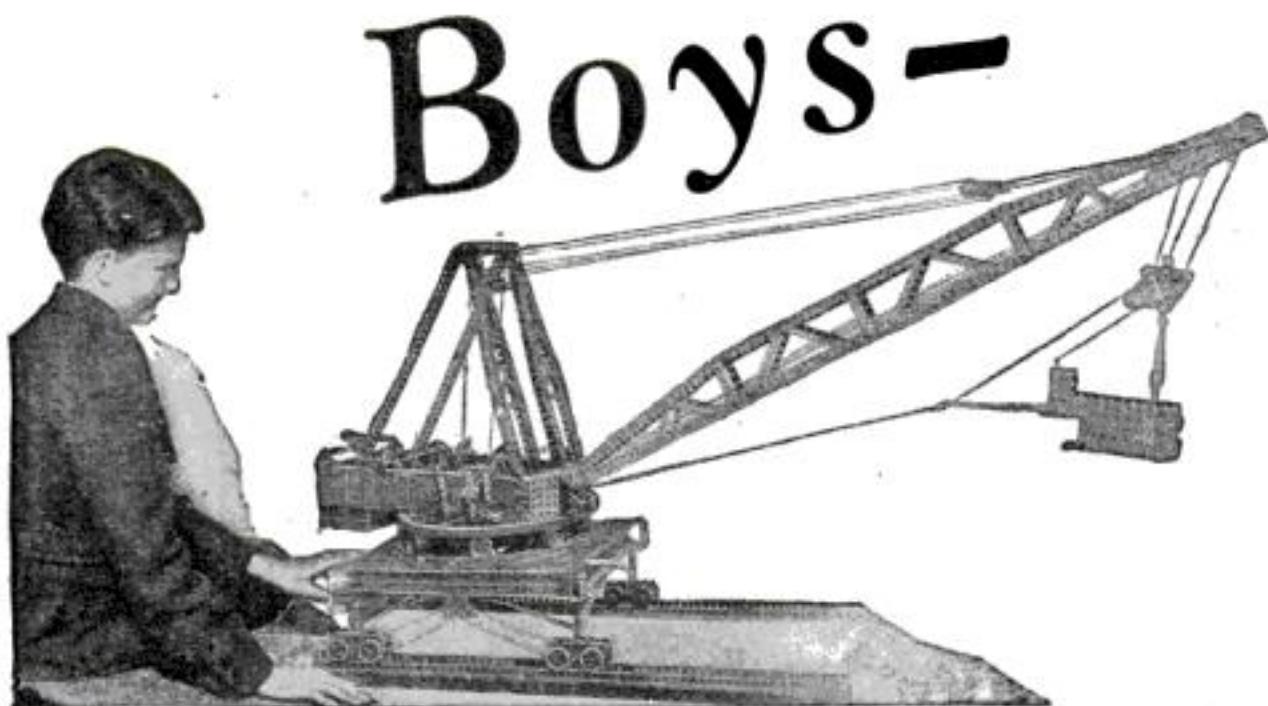
Dept. 211, 334 Fifth Ave., New York

Please send me at once complete information about the Radialamp loud speaker.

Name.....

Address.....

City..... State.....



Boys— YOU—yourselves can build this Dragline that really digs

JUST imagine! a perfect little Dragline that digs, then swings its load and dumps it like the model dragline shown above.

You can build and operate one yourself, if you have Meccano—engineering for boys. And when you are through with it you can build dozens of other models—skyscrapers, bridges, cranes, watchtowers, automobiles even, with the same Meccano outfit.

For Meccano parts are real en-

gineering parts in miniature; gears, pulleys, couplings, girders, beams, and can be put together in any number of models. They are strong and accurately made and fit together perfectly, so that the machines work easily and smoothly.

You don't have to study to build with Meccano. For with each set is a big book full of pictures showing just how models go together.

For sale at most department, toy, hardware and sporting goods stores. Sent direct on receipt of price if your dealer cannot supply you. Prices of outfits from \$1.00 to \$45.00.

This Book Sent FREE

Send us your name and address with those of three of your chums and we will send you free our new book, "The Magic Carpet," which tells all about Meccano and the joys of Meccano building.

MECCANO COMPANY, INC.
Division K-1, Elizabeth, N. J.
In Canada: Meccano, Ltd., 45 Colborne St., Toronto



MECCANO ENGINEERING FOR BOYS

IMPORTANT NOTICE

Not all construction toys are Meccano. Meccano is the original Steel Construction Toy. It has the greatest variety of parts and builds the most models. Insist on the genuine Meccano. This label is on every box.



**MECCANO
COMPANY, Inc.**
Div. K-1,
Elizabeth, N. J.

I attach my name and address and those of three of my friends. In exchange please send me your Meccano book.

My name.....
Street.....
City..... State.....

How to Become a Successful Electrician
By Prof. T. O'Conor Sloane. The studies to be followed, methods of work, field of operation and the requirements of the successful electrician are pointed out and fully explained. 202 pages. Illustrated. Price, \$1.50.

POPULAR SCIENCE MONTHLY
250 Fourth Avenue NEW YORK

Building and Flying an Aeroplane
A practical handbook covering the design, construction and operation of aeroplanes and gliders. Cloth, 150 pages. 50 illustrations. Price, \$1.60 Postpaid

POPULAR SCIENCE MONTHLY
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"Buzz Boice" Makes It Easy to Build Things

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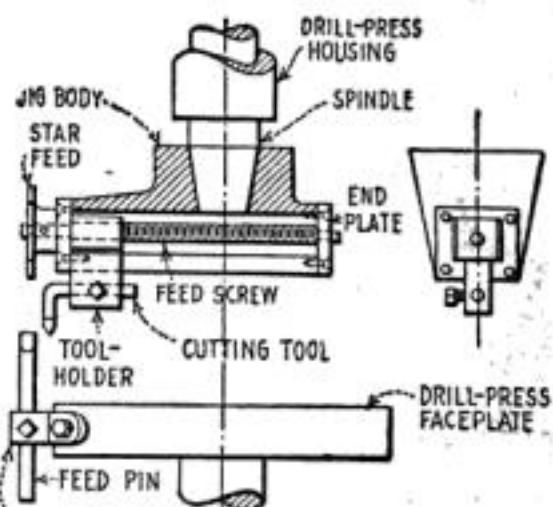
Jig Adapts Drill Press for Facing Operations

IN THE small shop the need for another lathe often is felt. As a rule, a drill press is to be found idle, and this can be used for certain classes of work in connection with the jig that is illustrated below.

The size of this jig, which is designed especially for facing operations, is governed by the drill press on which it is to be used, therefore no dimensions are given for it.

The jig body is cast iron, with a hub about 1½ in. larger than the drill-press spindle. A tapered hole is shown, but if the drill press has a straight spindle, provide the hub with a hole to suit and tap it for a setscrew.

A T-slot is planed through the body as indicated and four holes are drilled and



This drill-press facing tool is moved automatically by a star wheel on the feed screw

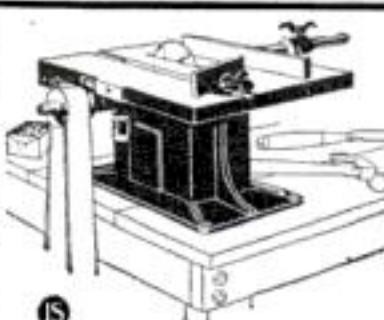
tapped to take the screws holding the end plates in position. The feed screw is threaded 16 or 20 threads to the inch and turned down at the ends to form shoulders, which fit against the end plates.

A star feed wheel is pinned to the end of the feed screw. A bracket is fastened to the drill-press faceplate, and this holds a feed pin in such a position that it comes in contact with the star feed wheel as the jig revolves and thus turns the feed screw.

The tool-holder is a block of steel, made a sliding fit in the T-slot. It is tapped to an easy fit for the feed screw. A hole is provided for the cutting tool, which is held in position by a setscrew.—F. N. C., Buffalo, N. Y.

Improving Electrician's Fish Wire by Ball on End

IN INSTALLING a headlight turbine generator in a locomotive and wiring a headlight on an accommodation coach, there was one point where it seemed impossible to get a fish wire through the bends in the flexible steel conduit. The wire had a closed loop, but it would not go through in an hour of maneuvering. Finally I took the fish wire to the shop, wrapped No. 18 bare copper wire around the loop, tinned and soldered it, and dressed it down with a file. This formed a smooth ball about ½ in. in diameter on the end of the fish wire, which could be pushed through the conduit.—S. H. SAMUELS, Oakland, Calif.

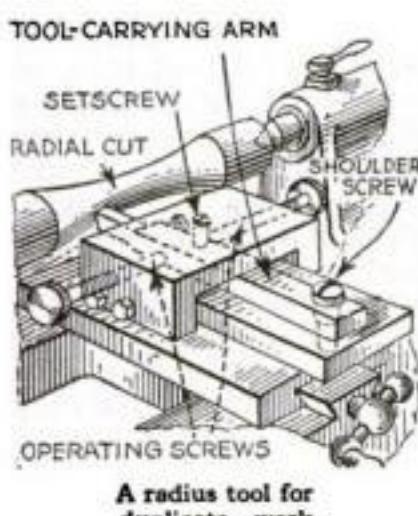


Simple Lathe Fixture Aids in Turning Large Radius

A CHEAPLY constructed radius-turning fixture is shown in the accompanying illustration. For turning large form milling cutters and similar work, where a number of duplicate pieces are required, this fixture gives excellent results.

It is made entirely of steel. The arm that carries the tool swings on a stud and the distance from the point of the tool to the center of this stud is the radius required to be turned. A square slot in the end of the arm is provided to hold the toolbit.

The tool may be fed right and left by manipulating the knurled thumb-screws on the sides of the fixture.—S. L. ROBERTS, Hoboken, N. J.



A radius tool for duplicate work

Adjustable Centering Tool

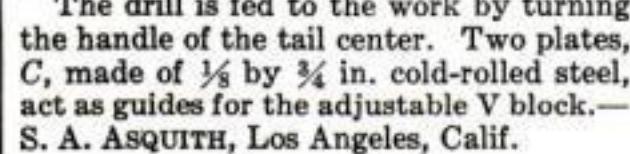
THE illustration shows a simple adjustable device for centering round stock up to $1\frac{1}{4}$ in. in diameter in the lathe. It will center any number of pieces accurately and rapidly. In use, the drill is held against the center while the piece rotates in the V block, which is adjustable for any size shaft up to the limit mentioned.

The device requires one piece, A, of cold rolled steel 1 in. square and 3 in. long, and one piece of cold rolled steel, B, 1 in. square and $2\frac{1}{2}$ in. long. In one end of B is cut a V, which serves as a steady-rest for the shaft. This piece is fastened to A with the thumb-screw D, which passes through an elongated slot in the drill-holder.

The drill is fed to the work by turning the handle of the tail center. Two plates, C, made of $\frac{1}{8}$ by $\frac{3}{4}$ in. cold-rolled steel, act as guides for the adjustable V block.—S. A. ASQUITH, Los Angeles, Calif.

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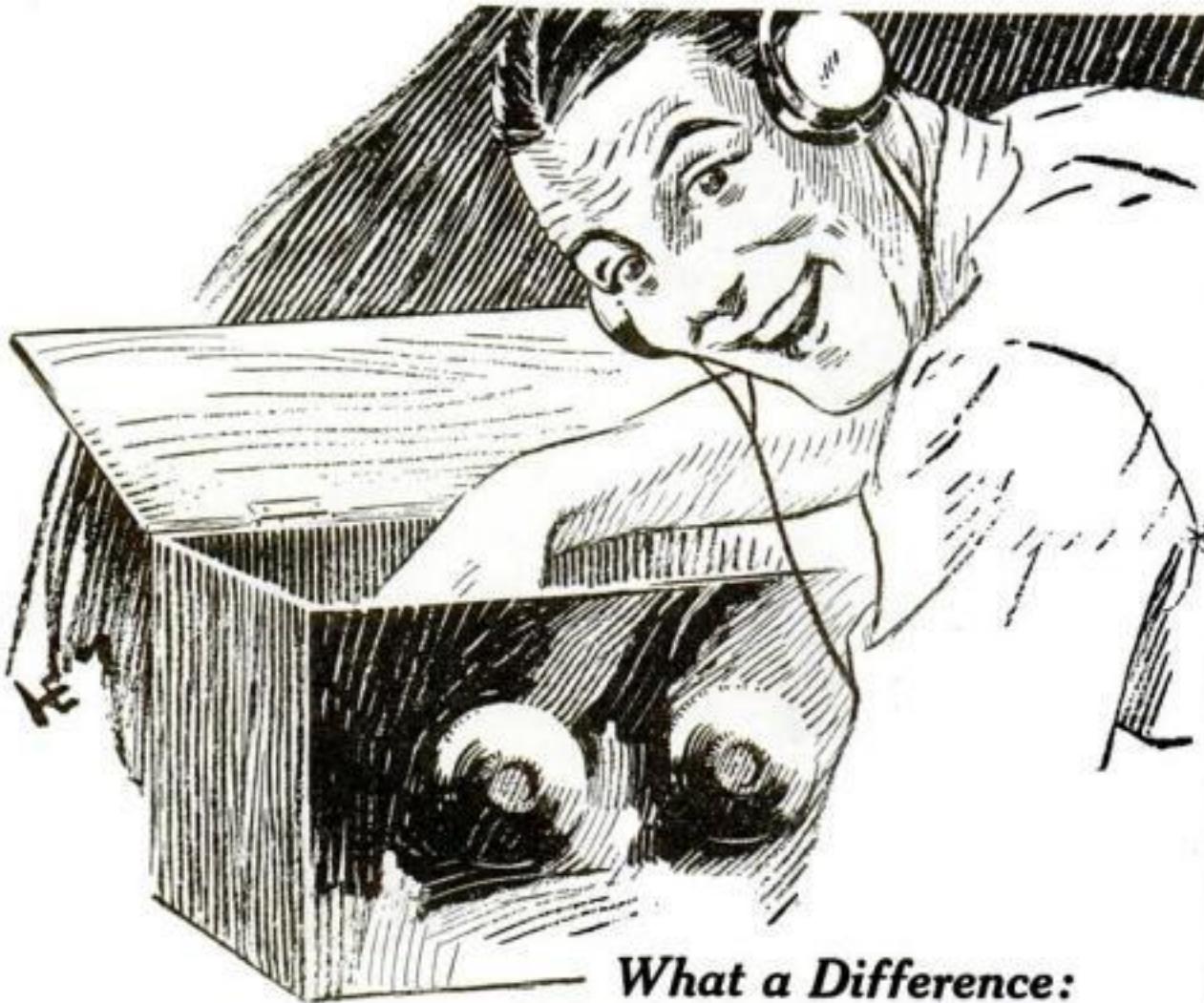


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Secrets of Success in Working with Glass

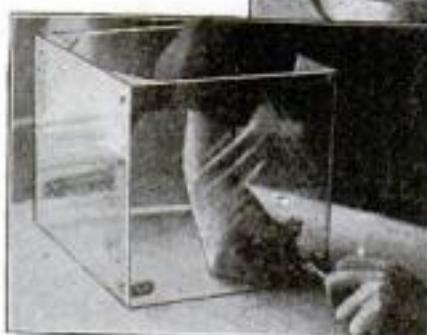
By Ernest Bade, Ph.D.

ALTHOUGH glass is one of the most difficult substances with which to work, there are innumerable uses for it in the home workshop.

To cut glass, both a steel disk and a diamond are used most, although larger crystals of carborundum will serve efficiently. If the glass is to be shaped in odd angles, it may be cut with a pair of scissors, provided it is not too thick. Place the glass in a pail or basin of water and cut under water. A smooth edge cannot be obtained and the edges will be slightly jagged. Remember, while cutting under water, that the glass will only be roughly shaped, but even this is a great aid where no other method can be employed.

Drilling holes in glass is not so very difficult. The old method utilized a discarded triangular file, ground to a sharp triangular point and used in a brace with slight pressure. The point of contact was moistened with turpentine. This was a tedious job.

The more recent way and one that is quicker is to use a brass



Cutting glass under water (above) and bolting a glass cover together (at left)

or copper tube with thin walls instead of a file. The tube is placed in the brace and drilling is accomplished with powdered carborundum as a cutting agent. A guide of wood keeps the tube properly centered. Use slight pressure and keep the glass cold with turpentine to prevent cracking.

It is possible to use a motor or a drill-press as a driving agent, and then it becomes a simple matter to drill a number of holes for glass radio cabinets and similar work.

Canada balsam, thick varnish, or thick resin solution, the resin being dissolved in hot turpentine, may be used to make ground glass transparent. This is of special value to the photographer. A small, round transparent hole in the center of the ground glass of the camera can be used most effectively for focusing sharply with the aid of a hand lens. Place a drop of the solution on the ground side of the glass and cover with a very thin piece of clear glass. Let it harden and scratch off the surplus cement.

It is also possible to imitate ground glass. For this purpose a varnish is made of a teaspoon of gum sandarac, $\frac{1}{5}$ teaspoon of gum mastic, $\frac{1}{2}$ glass of ether and $\frac{1}{4}$ glass of benzol. When dissolved, pour on the glass to be frosted,

(Continued on the next page)

Secrets of Success in Working with Glass

(Continued from preceding page)

take great care that no flames are near, as ether and benzol are very inflammable.

In silvering mirrors the following directions should be closely followed or the mirror finally obtained will be patchy.

First, clean the mirror. It must be perfectly and absolutely clean. Wash it well with soap and water and rub dry with a clean rag. If necessary, dip the glass in a solution of potassium bichromate in a glass tray. Dissolve as much as possible of this chemical in cold water and for each glassful used, add about two medicine droppers full of sulphuric acid and mix. Let the glass remain about five minutes in this bath and then rinse

under the tap for two or three minutes. Dry with a clean rag. Pour on a little acetone or wood alcohol and polish the glass with the rag.

When the glass, or at least that



Waxing a cardboard tray (above) and mixing solution for making a mirror (at right)



side which is to receive the silver coating, is perfectly bright and spotless, take great care not to touch it with the fingers.

Place the glass in a tray of such size that $\frac{1}{4}$ in. or less is left at the edges. If a tray is not at hand, make a cardboard tray to fit. This should be made of one piece, about $\frac{1}{2}$ in. high. Melt wax or paraffin and coat the entire inside of the tray; then place the glass in it.

Carefully prepare these solutions: First dissolve $\frac{1}{2}$ gram of silver nitrate in 200 cubic centimeters of water and add $\frac{1}{2}$ gram of Rochelle salts. When dissolved and after it has been brought to the boiling point, filter through a filter paper.

Next dissolve 1 gram of silver nitrate in 100 cubic centimeters and add strong ammonia water, drop by drop, until the brown precipitate first formed is redissolved. Add $\frac{3}{4}$ gram more of silver nitrate and add 100 cubic centimeters of water. Filter this second solution also.

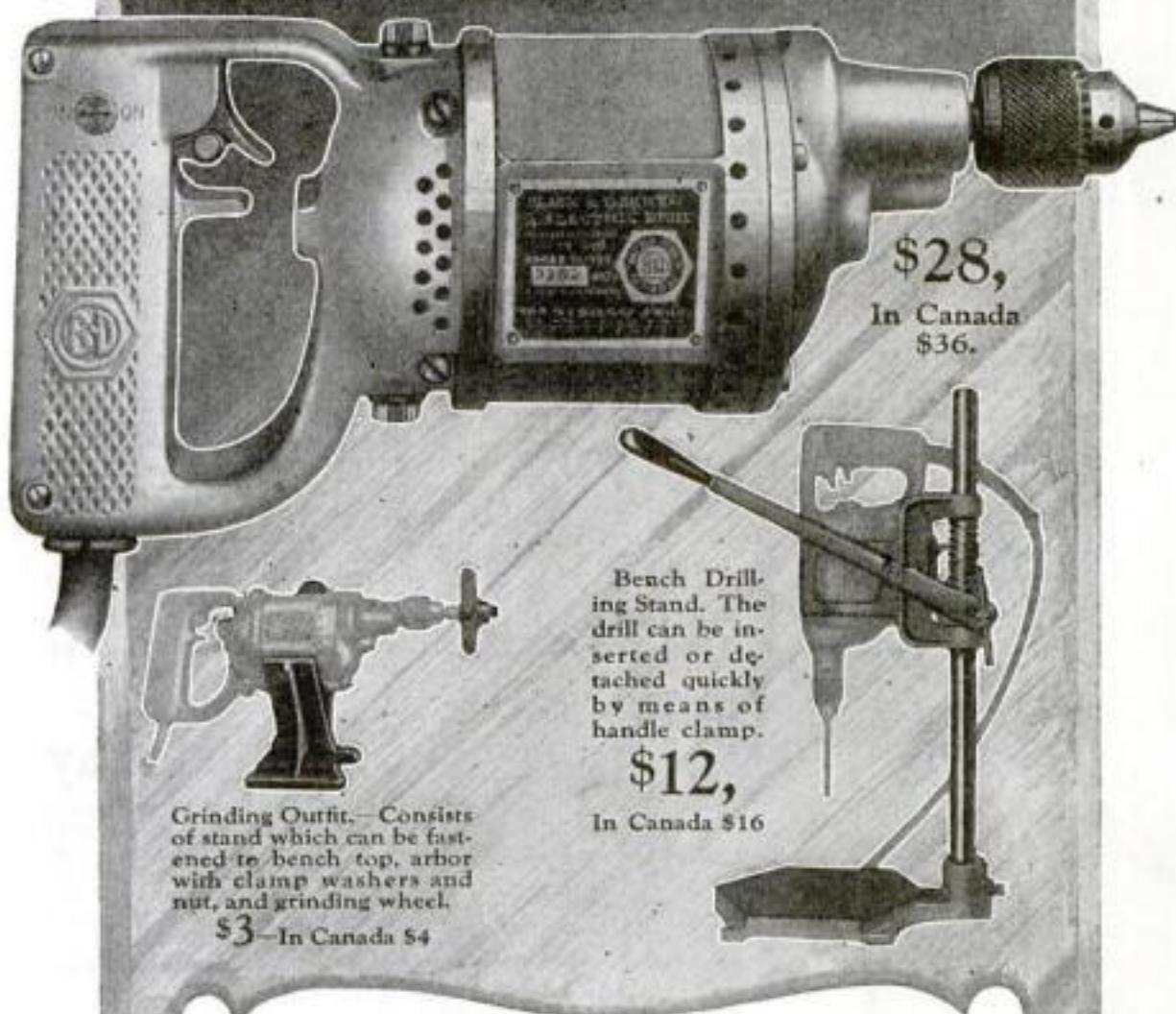
Then take equal quantities of these two solutions, mix with a glass rod and pour the mixture quickly but gently over the glass to be silvered. Leave in the solution for two or three hours or overnight. Then take out the glass, hold over the tap and let a gentle stream of water run over it for a few minutes. Stand up to dry. Afterward apply a thin coating of fluid asphaltum varnish, using a soft camel's-hair brush to avoid scratching the silver.

Wash your hands thoroughly after using the silver nitrate, and if stained, dip the fingers in dilute ammonia water.

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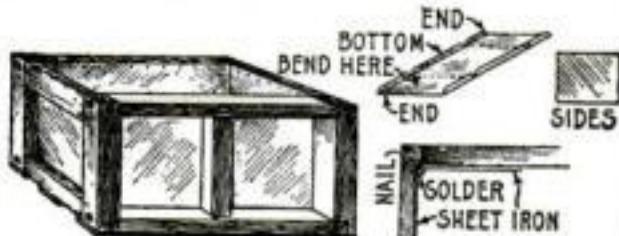
E.S. GIVENS, 153 Chemical Bldg., Kansas City, Mo.



Building Sheet-Metal Tanks

IN THE building of any machine that requires a water vat or tank, a galvanized sheet-iron tank is generally the most practical kind to use. A wooden tank will warp and leak, while a metal tank has neither of these faults. The same holds true in regard to watering troughs, tanks for gravity water systems, and other tanks necessary on a farm.

The average constructor has not the needed tools to make the customary lock-seam joints and thinks a metal tank



A serviceable metal tank for farm use made almost as cheaply as a wooden one

rather costly compared with a wooden one. This is not the case, however, as will be found if one builds the tank by the method illustrated.

Generally I use 3 by 3 in. corner posts, 2 by 3 in. side and end pieces, with 2 by 2 in. braces, if the tank is a large one. The joints are held by $\frac{3}{8}$ -in. lag screws.

With such a substantial framework, very light weight sheet iron can be used, thus cutting the cost down to that of an all wood tank. Lock-seam joints are unnecessary; the sheet iron is cut, bent as shown, and nailed in place within the woodwork. Solder is then run along the lap seams and over the nail heads.

The result is a tank that will not leak, even after it has been allowed to dry out. It will not warp and is lighter in weight and better in appearance than a wooden tank.—JONAS BYBERG, Silverton, Ore.

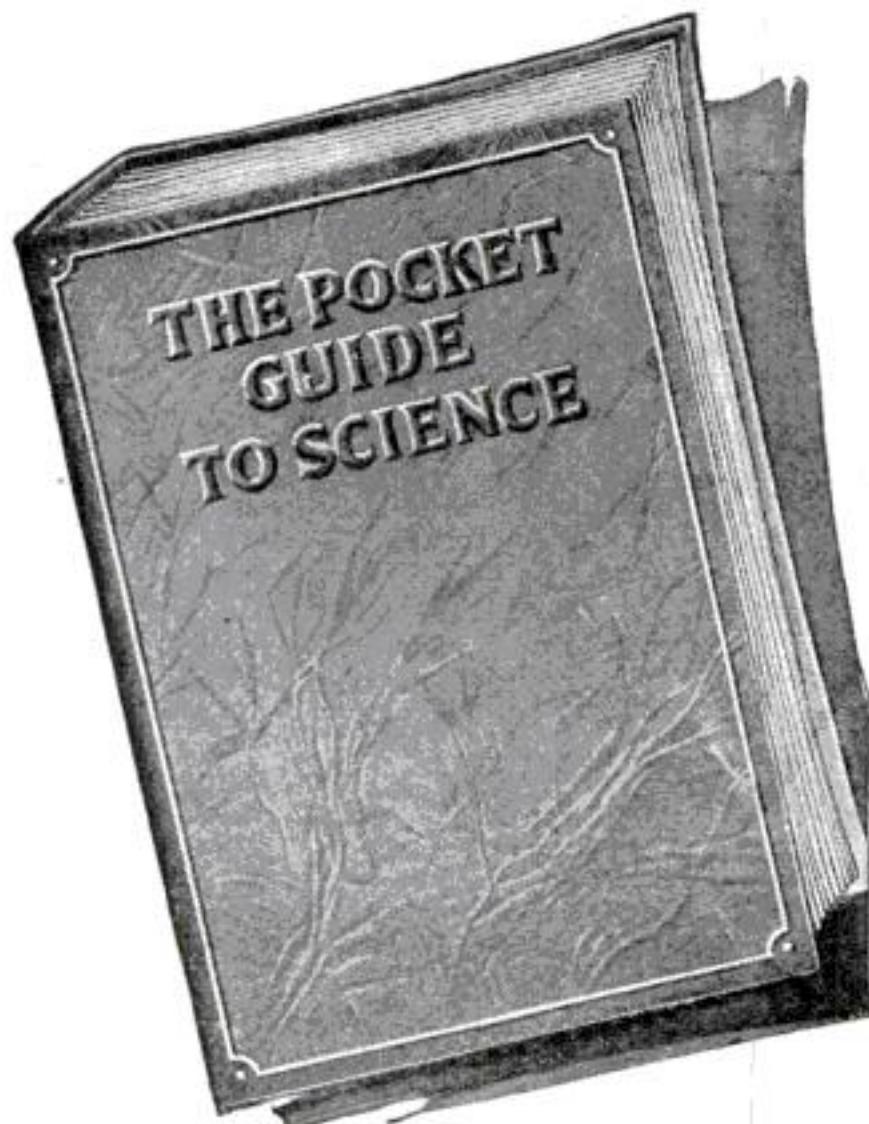
Cork Paint Reduces Dampness on Water Pipes

MOISTURE in the air often condenses on cold-water pipes that run through a warm room. This difficulty sometimes may be overcome simply by giving the pipes or other metal surfaces three or four coats of paint. A much more certain method, according to Henry A. Gardner of the Scientific Section of the Paint Manufacturers' Association of the United States, is the following:

Give first a priming coat of metal protective paint, then a coat of spar varnish containing whatever color pigment is desired. Before the varnish dries, press ground cork against the surface to form a thick coating. When the varnish has dried, two coats of oil paint or enamel complete the finish.

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- What are electrons?
- Is electricity a form of matter?
- What is a crystal?
- How large is the universe?
- Why do the stars twinkle?
- How do we know what the stars are made of?
- Is the inside of the earth molten?
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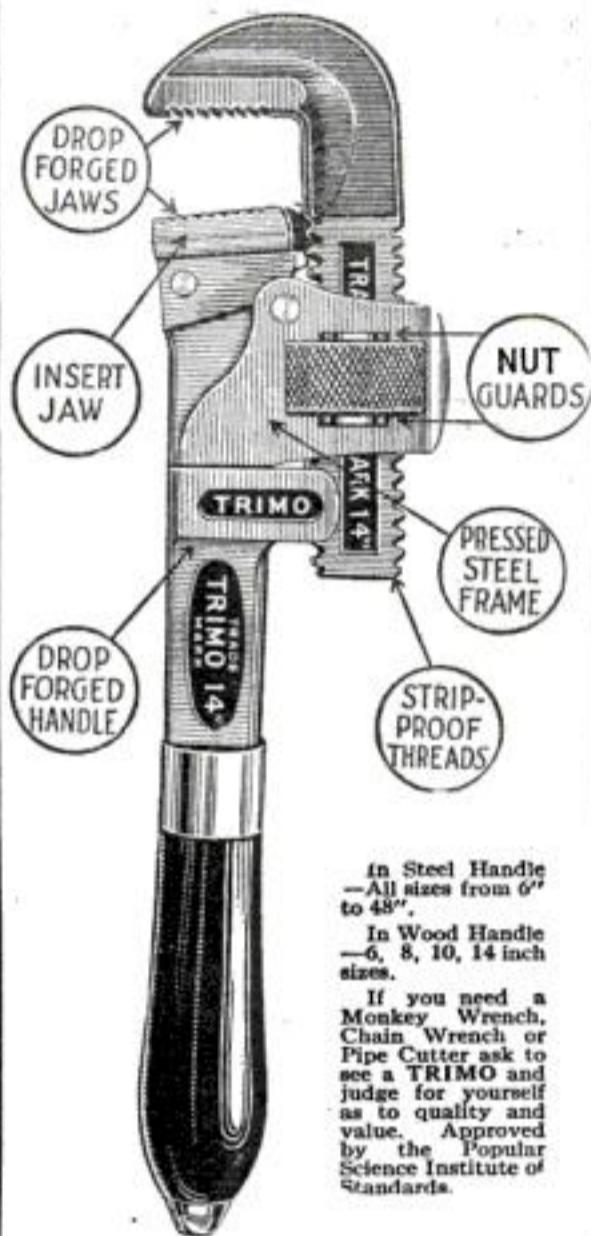
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How to Time Auto Engine Valves

THERE are two distinct phases in the timing of an automobile power plant.

Properly speaking, engine timing is the timing of the camshaft to the crankshaft so that the valves will open and close in time with piston travel. Also in time with the valve opening and piston travel, must be the opening of the contact points in the breaker box, which will insure a spark being delivered at the right instant; this is ignition timing. In this month's article consideration will be given to engine timing, followed next month by a discussion of ignition timing.

Two distinct methods are used to time the crankshaft and the camshaft gears or chain drive. Engines are designed to allow the intake valves to open on top dead center or a few degrees after top dead center exhaust stroke, piston number one being considered. Most engine flywheels have top dead center of cylinder Nos. 1 and 4, or Nos. 1 and 6, marked on the flywheel to aid the workman in this operation.

Other marks usually are found close to the T. D. C. (top dead center). These may be stamped E. C. or I. O. The first stamping refers to exhaust valve closing, and the second stamping refers to intake valve opening. The distance past top dead center at which these markings occur on the flywheel is measured in degrees.

It might be said that general practice on engines would have the exhaust valve closed 5 deg. past top dead center, and intake valve open at about 3 deg. later, or 8 deg. past top dead center.

In case an engine has not been marked, or the workman desires to mark it when rebuilding, all he needs to do is to remember that there are 360 deg. in the rim of the flywheel, and if a tape line is used for measuring the circumference of the flywheel, each inch will be found to contain a certain number of degrees. In this way it is easy to mark the approximate position at which the exhaust valve should close and intake valve should open. For a car owner this might prove quite valuable in checking without having to dismantle the job. A pointer on the cylinder block or flywheel housing is used to indicate top dead center when the mark on the flywheel is in line with it.

Another method of setting engine timing is to use piston travel. Having the engine set on top dead center, the travel of piston No. 1 is noted. As a matter of general practice it might be stated that the piston travel in cylinder

By Ray F. Kuns
Principal of Automotive Trades
School, Cincinnati, Ohio

No. 1 would be 1/64 in. from top dead center to the closing of the exhaust valve, and 1/32-in.

travel to the opening of the intake valve.

In actual practice it is impossible, of course, to obtain the exact setting of these valves in every instance, for the simple reason that gears wear and chains stretch. However, the owner or repairman will depend upon the markings and settings given to indicate when he has the best possible setting for the particular engine being worked on. If he should miss the setting as much as one tooth on the timing gear, his checking of the job according to the information given would show him that a mistake had been made. He would then want to repeat the timing operation and recheck to prove his work.

The reader will understand, of course, that the adjustment of the valve lifter screw to the setting recommended by manufacturers would have a great deal to do with the point of opening and closing the valves. In fact, this is the first necessary step in valve timing.

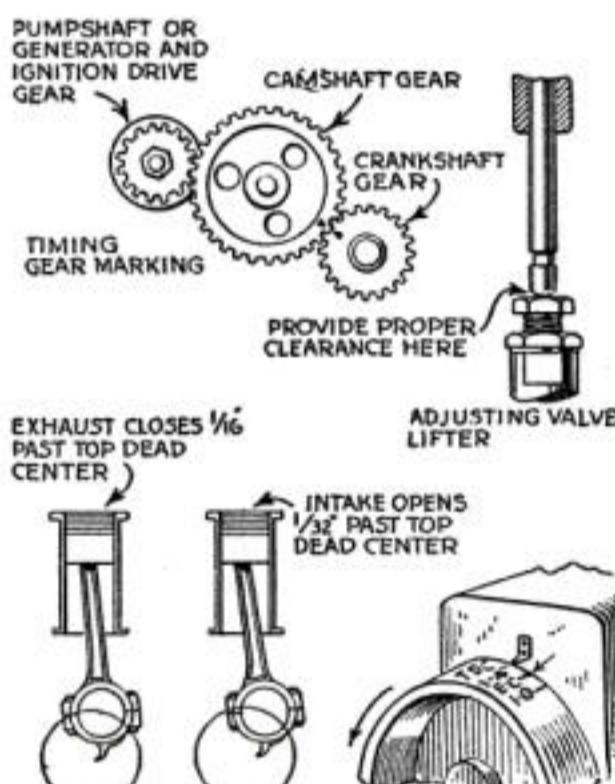
If the manufacturer has designed the engine to operate with setting of .004 in. clearance, and the workman allows .015 or .020 in. clearance, it is quite possible that he might miss the actual timing of the engine by one tooth on the gear or one link on the chain. Generally speaking, if the manufacturer's specifications are not at hand, the T- or L-head motor should have from .004 to .006 in.

clearance between the valve stem and the valve lifter, except in the case of the Ford. In the case of a valve in head engine, the clearance may run as much as .012. Usually, however, it will fall somewhat lower, being nearer .008.

Wherever there is any question about the timing of an engine in service, the first step is setting the valve lifters, cylinder No. 1, with a correct valve clearance. The next step is to secure top dead center exhaust stroke cylinder No. 1, exhaust valve just closing, intake valve just opening. If there then seems to be a question about the setting of the engine timing gears, it would be well to remove the timing gear case, pull the camshaft gear and try changing the setting just one tooth. Or, in case the engine has been sluggish, it might be well to set it up just one tooth, keeping in mind the proper ignition setting.

As a rule, the markings on the timing gears may be depended on, but cases have been known where much better service

(Continued on page 123)



Timing gears, valve lifter, piston positions for exhaust and intake, and flywheel markings

How to Time Auto Engine Valves

(Continued from page 122)

could be obtained from the engine when the timing gear markings were ignored.

To prove the work, it is well to check over all cylinders of the engine with reference to the closing of exhaust and opening of intake, and where the specific information is at hand (with reference to any engine), it is just as well to continue the job and check the closing of intake and the opening of exhaust valves for each cylinder. Sometimes, in fact, this is necessary to secure an engine that will operate evenly. It may even be necessary to set the valve lifters a bit off standard adjustment of .004 or .006 in. in order to have the intake valves opening and exhaust valves closing at the proper distance past T. D. C.

Of course, if everything is according to the manufacturer's specifications and gears and cams are not worn out of shape, all valves will be opening and closing correctly when the specified valve lifter clearance has been secured, and the timing gears are set properly for No. 1 cylinder.

IN FORD work the valve lifters are not supplied with any adjusting screws. If less clearance is needed, the valve stem must be stretched or a new valve inserted, or if more clearance is needed, the valve stem must be filed away. This clearance on the Ford should never be less than .015 nor more than .031 in. The opening and closing of the Ford valves is as follows:

Exhaust valves open when the piston reaches $\frac{5}{16}$ in. from bottom dead center, and the distance from the top of the piston head to the top of the cylinder casting measures $3\frac{3}{8}$ in. The exhaust valve will close on top dead center, the top of the piston being $\frac{5}{16}$ in. above the top of the cylinder casting. The intake valve will open $\frac{1}{16}$ in. after top dead center and close $\frac{9}{16}$ in. after bottom dead center. The distance from the top of the piston to the top of the cylinder casting measures $3\frac{1}{8}$ in.

If the workman will set his valve lifter clearance so that the valve openings and closings are in accord with these figures for each cylinder, filing or stretching the valve stem as the case may require, he will insure a smooth operating engine as far as it is influenced by valve timing.

The steps of engine timing in order are:

1. Secure proper clearance between valve stem and valve lifter for intake valve, cylinder No. 1.
2. Set crankshaft with piston No. 1 $\frac{1}{32}$ in. past T. D. C. or according to intake opening marks on the flywheel (I. O.).
3. With cam gear off, set the cam shaft so that all clearance under intake valve stem, cylinder No. 1, has been taken up and valve is ready to open.
4. Maintain the two shafts in this position and install the cam gear in mesh with the crankshaft time gear.

If the gears are marked, they should be found with the marks coinciding.

Timing ignition, the sequel to this article, will appear in the December POPULAR SCIENCE MONTHLY.

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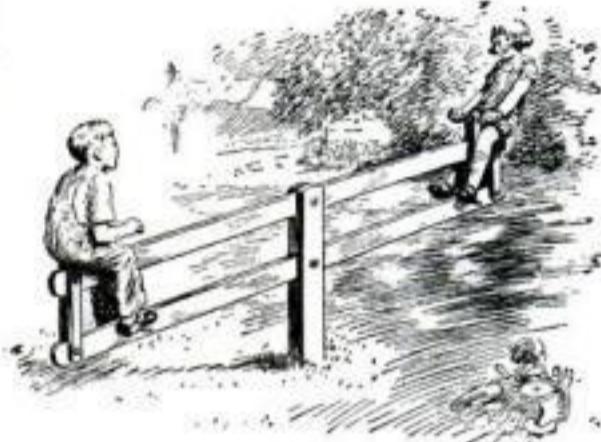
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Unique See-Saw Works on Pump Swing Principle

SMALL children take great delight in the see-saw illustrated for the reason that they can start it themselves by pushing and pulling on the handle-bars.

The construction is very simple. A 4 by 4 in. post is set firmly into the ground and a 1-in. slab is sawed out of the center for a distance of 2 ft. from the top. Two



This see-saw can be started and kept going by a brisk pumping action of the children

1 by 6 in. boards are placed in this slot and bolted as shown.

The seat and hand rests are cut from 2 by 2 in. strips, notched at the top and bottom so that they can be fitted over the long boards and bolted to them. Hand and foot supports are cut from broomsticks and driven through bored holes.

Two children of nearly the same weight should use this game. The see-saw motion is started and maintained by a pumping action.—DALE R. VAN HORN.

Connecting Tubes by Novel Method Insures Strong Joint

MANY of the usual methods of making a brazed or soldered union in steel or brass tubing have the fault of being weak at the junction. Threading and

coupling with a union weakens the tubing because the thread cut reduces the diameter of the threaded portion of the tube, and a loose sleeve over the ends of the tubes cannot be brazed or soldered with assurance that the metal will bind under the sleeve.

The departure from the usual practices that is shown has the advantage that an overlapping joint is formed in order that the junction can be brazed or soldered thoroughly. One of the tubes is split longitudinally at many places. The end of the tube to be joined to this is scarfed or beveled to a thin edge. The edges of the split tube are alternately bent in and out so that the beveled end will slip between them.—G. L.

AFTER varnishing furniture or wood-work, do not close the room too tightly.

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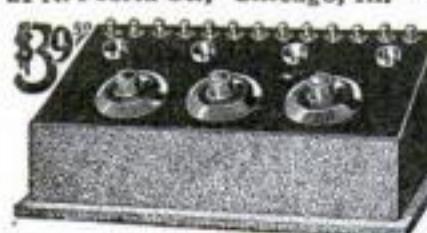
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Kitchen Work Table Is Popular with Amateur Woodworkers



Work table made by Charles C. Greenman aided by Home Workshop Blueprint No. 27

IN SMALL kitchens where space is at a premium a cabinet work table has obvious advantages. Details of an especially fine table of this type, with a swinging seat, are contained in Home Workshop Blueprint No. 27.

Charles C. Greenman, of Bedford, Nova Scotia, Canada, who made the table illustrated from that blueprint, writes:

We found it to be one of the greatest labor-savers; one is surprised at the number of steps it saves. I had no trouble at all in building it. I used native pine in the construction except for the panels, and got cottonwood plywood for them. You will notice that I have omitted the seat, as we already had a stool.

This month's blueprint is the rush-bottom arm-chair illustrated on page 90.

Complete List of Blueprints

ANY one of the blueprints listed below can be obtained from POPULAR SCIENCE MONTHLY for 25 cents. The Editor will be glad to provide, upon request, information relative to tools, material, or equipment.

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How Wiring Is Installed

(Continued from page 89)

switches and receptacles use slender, flat head screws to project $\frac{3}{8}$ to $\frac{1}{2}$ in. into the baseboard. Screws of gage No. 3 or 4 are suitable. The two location control switches, known as "three-point" switches, should be connected to be the equivalent of the diagram in Fig. 4.

Take off the switch cover and operate the switch, noting how the contacts are made and broken. Probably the most awkward job will be the switch on the stairway. You may have to saw off a floor board and remove it for the time being before wires can be put down the stairway wall.

Estimate the length of wire needed, cut them a foot longer, drop down the partition, "fish" them through the switch opening and then push up on the wires full lengths of flexible conduit.

To mount the switch, which is the usual snap switch, make a circular mounting board about 4 in. in diameter and $\frac{1}{2}$ to $\frac{5}{8}$ in. thick. Bore it out in the center for the wires and near its outer edge locate 4 screw holes so that a firm connection may be made with the lathe of the wall. Mount it solidly and then upon it fix the switch, after which the wires can be cut off and attached. Feed the flexible conduit right up to the switch after mounting and support the wires on the studding above, near the floor line.

TO RUN the wires to the source of power, locate the nearest live wires that are independent of all switches except the entrance switch. It is not likely that in an ordinary house the circuit to which you desire to connect is heavily loaded. However, if this live circuit feeds from 8 to 10 large lamps or from 12 to 16 small ones, it should not be used to supply the new circuit. In this case run a pair of wires down the wall to the switch box.

Before running the wires down the inside wall, cut two continuous lengths of flexible conduit as long as the run in the wall and slide them over the wires, adjusting them carefully in place. These wires should be supported near the top by the knobs shown at A, Fig. 5. The weight of the vertical wire must be taken firmly at this point.

Before handling the live wires, open the main entrance switch and take out the fuses. This may keep some uninformed person from causing trouble. Now make the joints by cleaning off the insulation, twisting tightly together the bright, bare wires, soldering, applying rubber tape, then friction tape.

Before putting in lamps examine carefully the whole circuit and satisfy yourself that it is right. Now put in lamps, screw in fuses and, while watching the fuses, close the main entrance switch. If the fuses hold, then try the control switches and watch the lights. Make sure that the lamp bulbs are good ones.

If all appear to be correct, let the lamps burn for half an hour. From time to time feel the joints and switches and receptacles to locate hot spots. Any so found should be examined and corrected at once. Finally, return the floor board to its place.

Day's Catch of Fish Kept Alive in Tow-Box

WHEN you go fishing in a boat you should have a tow-box like the one shown for keeping alive the fish caught. It is towed along behind the boat and rides in the water with the top flush with the surface. It is easily made and will keep fish alive all day long.

The box is built with bottom and three sides of screen, but with a solid wooden top, which is hinged, and a front of tin. The corner pieces are wood strips 1 in.



In use this fish box floats almost entirely submerged and keeps fish fresh all day long

square. The galvanized or copper screen should not be smaller than $\frac{1}{8}$ in. or larger than $\frac{1}{2}$ in.

Nail down the front half of the top solidly and hinge the back half to it. Provide the door with a hook and staple or hasp. Drive two staples in the front and to these tie a loose cord to which the tow cord is to be tied.

Universal Dowel Sharpener Made from Steel Block

A SIMPLE sharpener, for dowels of all sizes, which will never wear out, may be made from a piece of steel about $1\frac{1}{2}$ in. thick and 2 in. square.

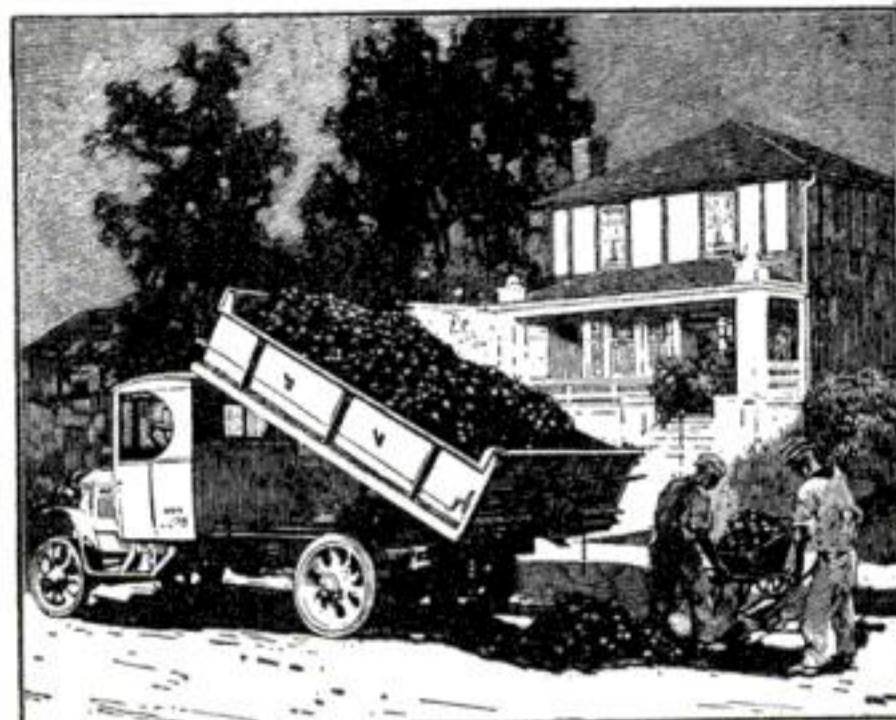
Find the center of the steel block, punch it as for drilling, and with a $\frac{3}{4}$ or $\frac{1}{2}$ in. twist drill, begin drilling as usual. When the hole is about $\frac{5}{8}$ or $\frac{3}{4}$ in. in diameter at the top, stop drilling.

In use the sharpener is placed on the bench. Hold a dowel upright in the hole and give it a sharp blow on top. This will crush a few end fibers sufficiently to permit an easy entrance of the dowel into its hole. When the dowel has been wet by the water in the glue, these fibers will expand, giving an increased hold.

This is a thoroughly practical sharpener. One has been in use in my shop for years. With little practice one ought to be able to sharpen about fourteen dowels to the single one sharpened by the old methods.—I. H. C.



For pointing wooden dowels quickly



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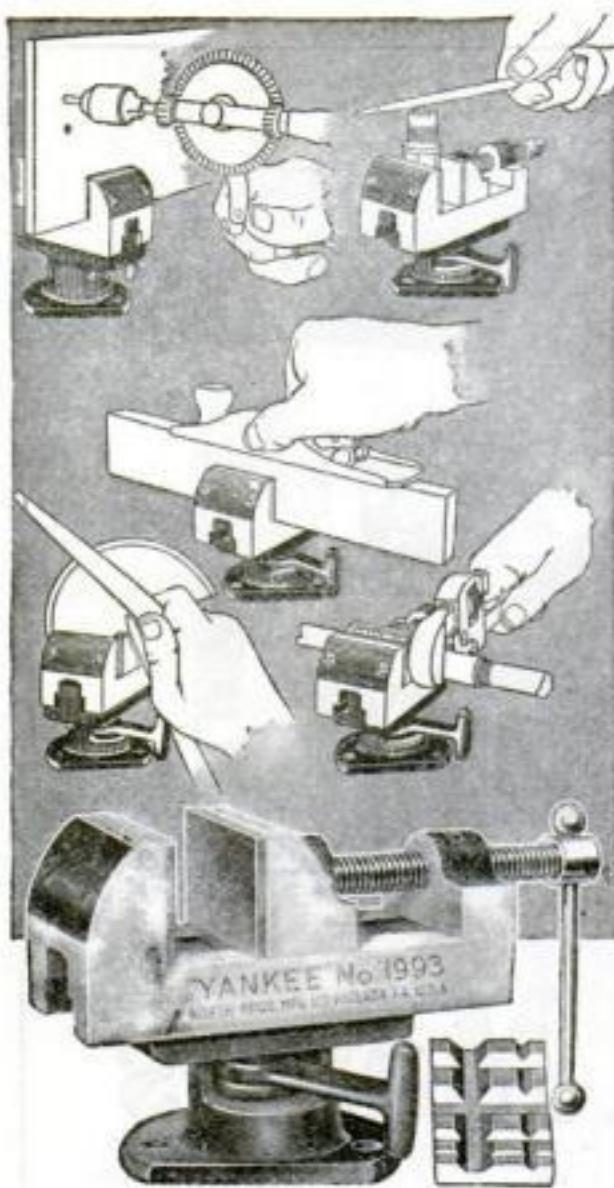
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Removable from base and can be taken from bench to machine. Can be locked in any position on swivel base.

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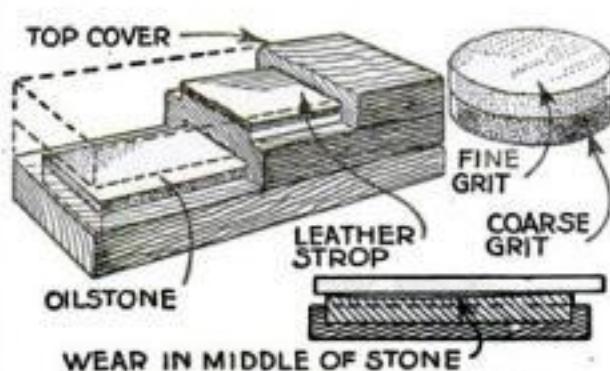
How to Keep Your Oilstone in Good Condition

THE oilstone is one of the most essential and often most abused tools in the home workshop. I have seen stones with a surface thoroughly glazed through the application of the wrong kind of oil or failure to wipe off the stone after use.

To keep your stone in condition, use a good grade of mineral oil, wipe the stone off when you are through with it, and keep it in its case or at least in a place where it will be free from dirt.

After an oilstone has been used for some length of time, it is apt to become hollowed out in the middle. Check your own stone by holding it before a light and laying the edge of a square along it. Any hollowing will be seen readily.

The surface of a worn oilstone may be dressed to a plane surface on the side of a grindstone, or it may be rubbed down



Oilstone with strop, method of testing flatness, and round combination stone

with an emery brick. Another method is to tack a sheet of emery cloth to the bench-top or other flat surface and rub the stone back and forth upon the cloth, stopping now and then to clean the dust from the cloth and to try the stone with a straight-edge. After once going to the effort to true a stone in this manner, any one will be likely to keep it in good shape thereafter by using all of the surface and not only the middle.

A piece of leather glued to the top of the oilstone case makes an excellent strop for putting the final edge on a tool. It is desirable to make a second cover, as shown, to fit over the leather and protect it from the dust, if the oilstone is not kept in a dustproof drawer or cabinet.

For 11 years I have used a round combination stone about 4 in. in diameter and have found it very satisfactory, as it allows a free circular motion in sharpening tools and wears evenly all over. One face is coarse for changing bevels and the other is fine for final sharpening.—S. W. B.

It is surprising that more woodworkers do not use a circular combination oilstone of the type just mentioned. Those who read Albert S. Peacock's argument for a round-and-round stroke in sharpening edge tools on an oilstone in his article, “Your Tools and Their Care,” in the September POPULAR SCIENCE MONTHLY, will appreciate the advantage of having a stone with a circular surface.

STAINS in woodwork caused by weathering or by an alkali usually can be removed with oxalic acid dissolved in water to the consistency of cream. This is applied warm and washed off with clear water, then sponge the surface with vinegar.



WHICH INSTRUMENT Do You Choose?

Whether it be saxophone, trombone, cornet, clarinet, flute—any instrument for band or orchestra—be sure it is a Conn!

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WORLD'S LARGEST MANUFACTURER

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1132 Conn Building
Elkhart, Indiana
Please send free book and details.
of trial offer on

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Name.....
Street or R. F. D.....
City..... State.....
County.....
(Write in pencil, please)



Wooden Giraffe Is a Unique Plaything for Children

By Rodger L. Simons

ALMOST any child, from the walking age to perhaps nine or ten, would be delighted to ride the toy illustrated.

The animal is made of 1-in. pine and is strong enough to carry children of eight, although oak would be a little stouter. The objection to oak is its weight.

The legs, neck, head, and body are sawed out with a coping-saw or, if available, a bandsaw. The body is made of three thicknesses, which are glued and screwed together after the center piece has been cut away to allow the neck to be put in place. Glue and countersunk screws hold the neck in place, although it could be swung on a pivot.

A small seat, cut from hard wood and shaped like a bicycle saddle, is mounted on the back. It is held about level with the ground by means of a small wedge-shaped support.

Before the legs are put in position a $\frac{1}{8}$ -in. hole is drilled through each hoof. The rear legs are held in place by screws, a steel rod being used to keep the axle holes in alignment.

The front legs are put in position in the same manner, except that before assembling, the inner top surfaces of each front leg should be planed at a slant so that the legs, when fastened to the body, will spread apart to aid the stability.

The three wheels are sawed, or, preferably, turned, from hardwood stock. The wheels are held on the axles, and the axles kept from sliding in the hoofs by a system of cotter-pins and washers. The rear wheel is mounted between the hoofs, while the two front wheels are at the extremities of an axle about 20 in. long. Steel rods are used for the axles. In the case of the giraffe photographed, the wheels are bronze bushed, for it does not take much hard service to wear the holes in the wood large, making the animal wobbly.

The ears, cut from cigar-box wood, are glued and nailed in position. The characteristic horns of the giraffe may be made of clothespins with the prongs sawed off, or they may be turned. A piece of rope, unraveled at one end, knotted at the other, and held in place by two heavy staples, serves as a tail.

The body should be given two coats of a cream paint, and, when thoroughly dry, spotted with brown. The eyes, mouth, and hoofs are black, while the seat and wheels may be red. The general size of the animal should be adapted to the size of the child who is to ride it. Other animals—elephants, tigers, camels—will suggest themselves for similar construction.



A toy to delight the children

60 MILES ON A GALLON OF GASOLINE

TESTS SHOW FORD CAN RUN 60 MILES ON A GALLON

The amazing fact that a Ford can run 60 miles on 1 gallon of gasoline was recently brought to light through tests conducted by America's foremost engineers, where it was shown that a gallon of gasoline contains sufficient heat units which if properly atomized and mixed with air would give this additional mileage. Great strides have already been made in this direction by the recent invention of a simple attachment which can be installed in a few minutes without any alterations to the motor. It is common for Ford Owners to make from 40 to 44 miles per gallon after this marvelous device is attached.

MOST WONDERFUL INVENTION TODAY BRINGS JOY TO EVERY FORD OWNER

Starts Ford Instantly

Starting a Ford Car in cold or zero weather is something every Ford Owner dreads—everybody realizes that difficult starting is an abuse on the starter and battery. Thousands of Ford Cars are "laid up" during the Winter just for these reasons. This great difficulty has been overcome. "The SUPER positively starts a Ford Car instantly in the coldest weather."

Marvelous Device

The SUPER is no trick affair—requires no mechanical adjustments and contains all the scientific principles of carburetors costing \$20 to \$35 and in its natural action uses up every particle of unused gasoline and breaks it up into a perfect vapor. The hitherto impossible is now realized by the SUPER.

Everybody Satisfied Saves 3 to 7 Dollars Per Month

The best investment I ever made. The SUPER is saving me from three to seven dollars each month, besides putting new life into my motor. A. H. WORRA, Iowa.

Makes 44 Miles Per Gallon

I have tried the SUPER and the results of the experiment are satisfactory. One quart of gasoline runs my Ford 11 miles over improved roads which is just about again as far as I could run with the plain Ford Carburetor. G. E. VODER, Penn.

Finds That Our Claims Are Correct

I find that your claims for increased mileage are correct and that a big saving is made by your SUPER, in fact, the best device I have met with in that line. M. J. VAN LEEUWEN, Mass.

Had No Previous Selling Experience

This letter shows what ambition does: "I sold six SUPERS in less than 2 hours tonight. I think it's a pretty good start—for it's the first thing I ever sold." E. MANGOLD, Ind.



The Heart of the Motor

Eliminates Oil Pumping In Front Cylinder

What a wonderful relief to Mr. Ford Owner when he realizes that he can run his car without the motor pumping oil in the front cylinder. Sounds like an awful lot to expect of any device, but that is what the SUPER does and this is only one of its many advantages because it puts real efficiency into any Ford Car.

Complete Combustion

The SUPER is so designed that it takes advantage of the present Ford Carburetor and properly atomizes the light as well as the heavy elements of the fuel, converting every atom of gasoline and kerosene into power, preventing liquid fuel from passing into the cylinders, thus avoiding carbon formation and oil dilution.

Easy to Sell Sells Like Hot Cakes

This is a recent letter from one of our distributors. "Enclosed find draft for 200 more SUPERS, rush us I need them badly. I sold and banked \$104.00 in one day. Hope to sell 1000 SUPERS next month." A. W. LEONARD, Penn.

Making Big Profits Every Noon

I have been working the SUPER at noon only. Yesterday noon I made more money with the SUPER than I did at my 11 hours' hard work in the factory all day. J. L. LEHNER, Wis.

\$60.00 TO \$150.00 PER WEEK EASY

You just can't help making Big Money selling the SUPER because a trial sells itself and soon everyone in the neighborhood gets talking about this marvelous device. Men like Leonard, Shaw, Manner, Kinsley, Peters, Sands, Beck and Hall are not exceptional salesmen but just the type of men that saw an opportunity and were quick to grasp it when within reach. No previous selling experience is necessary, just a little ambition on your part to make money is all we ask and we will extend the same opportunity to you. Spare time will pay you well. If you can devote your entire time so much the better, because the SUPER is a whirlwind seller and takes hold in a locality like wildfire.

Men Wanted Everywhere to Introduce

We want distributors in all parts of the country to take orders and deliver the SUPER and to look after the repeat business that is bound to follow and to such distributors we are willing to assign territory. You do not have to own a Ford to take up this proposition but if you have a Ford it is easier to explain its many advantages. However a Trial of the SUPER convinces the most doubtful person and tells a wonderful story.

A REAL FUTURE HERE

WEEKS SUPER CARBURETOR CO.
1304-703 Fond Du Lac Ave., Milwaukee, Wis.

MAIL TODAY

WEEKS SUPER CARBURETOR CO.
1304-703 Fond Du Lac Ave., Milwaukee, Wis.
GENTLEMEN: Please mail me full free particulars about
your wonderful invention.
Name _____
St. or R.F.D. _____
Town _____
County _____ State _____

The Vest Pocket BOOKKEEPER

A simple and concise method of practical bookkeeping, with short cuts

in figures and complete instructions for the correct keeping of books of accounts. A working model adapted to the novice and business man, by F. M. Payne; 160 pages, size 3 x 6 inches, \$1.00 postpaid.

POPULAR SCIENCE MONTHLY
250 4th AVENUE, NEW YORK

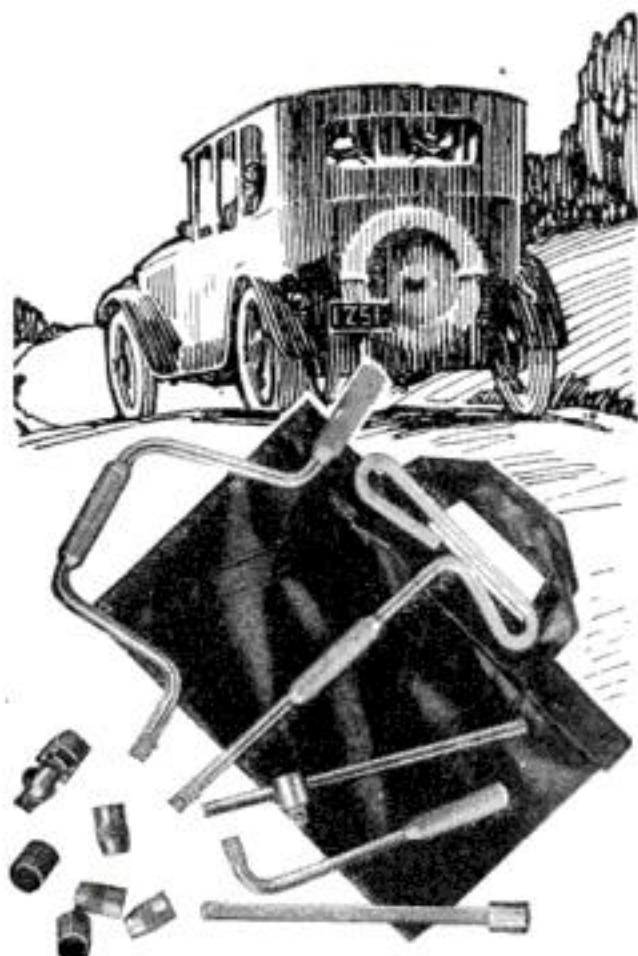
How To Make Things Electrical

Have the fun of doing it yourself and save half the cost

This book gives directions for making hundreds of electrical appliances and devices for the home, the shop and the garage. The simple directions and many drawings, make the work easy. 429 pp. Price, \$1.50 postpaid

POPULAR SCIENCE MONTHLY
250 4th Avenue, New York City

Destination Insurance



An important date—a train to make—a thousand-mile trip ahead of you—no matter which. The same question is in your mind as you climb in and give her the gun—"How's the old bus going to perform?"

A kit of Snap-On Socket Wrenches under the seat is the best destination insurance you could have. It will prepare you for road emergencies. Better still—prevent many of them by enabling you to properly service your car in your own garage. And in addition—help you to reduce costs and lengthen the life of your car.

There's a kit of Snap-Ons especially selected for your car by Snap-On Engineers—just a handful of sockets and handles—but they're made to reach and fit every nut and bolt. Get that? Made to reach and fit! Something you'll appreciate if you're using the misfit tools that came with your car. Snap-Ons are used and endorsed by over 250,000 garage mechanics. Name your car and we'll tell you what your kit will cost and where to buy it. Mail the coupon today.

Snap-on
INTERCHANGEABLE
Socket Wrenches

MOTOR TOOL SPECIALTY
14 E. Jackson Blvd., Chicago

Gentlemen:

Please send me full particulars about Snap-On Kit for car. (If interested in Master Mechanic's Kit, check here.)

I buy tools from.....

Name.....

Address.....

Old Light Bulb Forms Electric Perfumer and Deodorizer

AN ELECTRIC perfumer, deodorizer, and fumigator may be made from an old electric-light bulb, a porcelain socket, and a wooden base 1 by 6 in. Pinch off the tip of the bulb, cut off a section of the top with a diamond or a file dipped in turpentine in which a piece of camphor has been dissolved, and break off all the filaments except the lead wires. Fasten the socket on the base and connect with the electric-light wires. The device may be ornamented, if desired.

Various solutions may be placed in the bulb, each with a pinch of salt to make it conductive. When the current is turned on, the water will boil until it evaporates below the lead wires. The current then is turned off automatically. This insures safety in operation.

A solution for coughs, colds, and croup is: Oil of eucalyptus, 60 drops; menthol, 60 grains; tincture benzoin compound to make 2 oz. One teaspoonful of this floated on the water is sufficient.

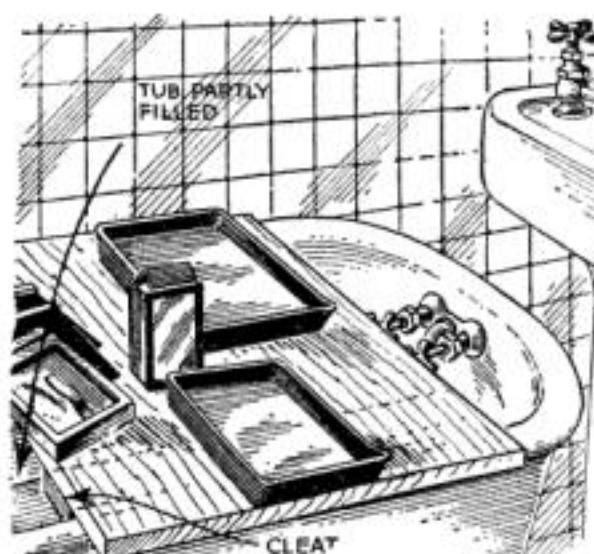
For fumigation: A 40-per-cent solution of formaldehyde used without diluting. This also kills flies, mosquitoes, and moths. Shut the closet or room door and allow no one in while fumigating.

As a deodorizer, use a few drops of oil of lavender or other oil or perfume in the water.—H. C. C.

Board across Bathtub Aids the Amateur Photographer

THE amateur photographer who uses a bathtub for developing purposes will find his photographic work greatly aided by a cleated board made the right size to rest across the tub and form a table.

The bathtub should have a few inches of water in it for rinsing plates, and the



A working table for the home darkroom that can be stored away conveniently

wash-basin provides the running water necessary for plate washing. The board holds the trays and red lantern, if a red colored bulb is not available to screw into the electric-light socket.

Please return to W. H. C. Box in a
gold van
when
the
nation
came
cause
Alfieri
cotton
grade
fringe
LOST—The cap of my Shaving
Cream Tube. Somewhere be
between the wash basin and the
bath tub. Will the finder please
return to this irritated shaver.
R. P. C. Box 141.
LOST—A diamond stick pin fi
comfort
smokin
likeness

Found

~a shaving cream cap that can't get lost!

You'll spot the convenience of this new Williams cap just as you spotted the finest cream on earth to shave with. Every Williams user knows the speed qualities that make it so:

- Williams lather is heavier, finer in texture. It holds the moisture in so that all of every hair is quickly softened.
- A gentle lubricant in this lather lets the razor work smoothly, eliminating painful razor-friction.
- There is an ingredient in Williams that's helpful to the skin. Your face remains in delightful condition.

Ask any dealer to show you one of the new tubes with the Hinge-Cap. Open the tube and note how pure and white the cream is. No coloring matter in Williams! It is the art of shaving-cream making at its highest.

Large tube, 35c; double size tube, 50c, containing twice as much cream.

THE J. B. WILLIAMS COMPANY
Glastonbury, Conn.

The J. B. Williams Co. (Canada) Ltd.,
St. Patrick St., Montreal

Aqua Velva is our newest triumph—a scientific after-shaving preparation. For free trial bottle write Dept. 1011.

Williams Shaving Cream



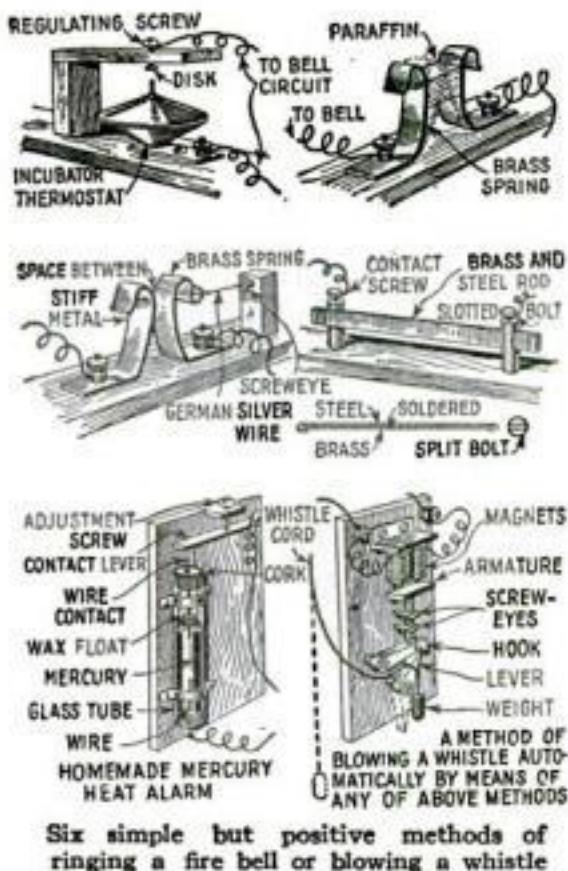
Automatic Electric Fire Alarms**You Can Build Easily**

By L. B. Robbins

SIX of the simplest and most effective ways of rigging up alarms that will warn of fire automatically are illustrated below.

A thermostat from an old incubator may be mounted on a base and a small scaffold built over it to carry an adjustable contact, which can be raised or lowered to meet the top pin of the thermostat. When the thermostat expands, the top touches the screw, completing the circuit and ringing the alarm. Adjusting the screw will determine at what degree of heat the contact shall be made.

By arranging two vertical brass springs with a small block of paraffin between them, a simple alarm can be constructed. Paraffin will melt at a certain heat, letting the springs come together and ring the bell. Several of these along a fire-alarm



Six simple but positive methods of ringing a fire bell or blowing a whistle

line would be valuable in cold rooms, such as in an ice-house.

A similar device consists of two vertical springs. One of them is held about $\frac{1}{4}$ in. from the other by a German silver wire stretched over to an upright a foot away. When the heat expands the wire sufficiently to allow the springs to touch, the bell circuit is completed.

A simple thermostat may be made by soldering a steel and brass strip together. This is fastened horizontally in a slotted binding post. At a certain heat the combination will bend and make electrical contact with a binding post at the opposite end.

To form a mercurial alarm, a glass tube containing mercury is fastened at one side of a board. One alarm wire projects through the bottom of tube, while a second wire is forced through a wax float resting on top of the mercury. An adjustable lever then is fastened above the float wire as indicated and connected in the bell circuit. As the mercury is expanded by the heat, the float rises and finally makes contact with the lever.

(Continued on page 134)

Popularity Plus!



Yours-with this most winning of all musical Instruments

It's easy to be popular - to be in demand socially - to be welcome everywhere - with an irresistible Buescher Saxophone.

Don't be a wall-flower. Don't be a dawdler. Step out of the crowd and into the "picture." Be able to do something to earn your welcome. Learn to play a



The model
shown is
the new
1924 Alto
Buescher
Saxophone

*E a s y
to Play
E a s y
to Pay*

Easy? - you'll be astonished to see what you can do in a few days. Most people are able to play a few pieces of popular music in two or three weeks.

It's great fun - learning - and you are mastering an accomplishment that will mean big money to you if you decide to use it commercially.

Easy payments to suit your convenience. 6 days' free trial. Send the coupon or a postal for your copy of the free Saxophone Book described below. Mention any other instrument in which you may be interested. No obligation. Do this today.

BUESCHER BAND INSTRUMENT CO.
Everything in Band and Orchestra Instruments
300 Buescher Block, Elkhart, Ind.

*Free this Beautifully Illustrated
Saxophone Book*

This beautiful book
shows how easy it is
to learn to play a
Buescher. In it you
will find the first
lesson chart. It
shows all the differ-
ent models and tells
what each is used for.
Hundreds of pictures.
64 pages. You must
have this fine book.

Buescher Band Instrument Co.,
300 Buescher Block, Elkhart, Ind.
Gentlemen:
I am interested in the instrument checked below:
Saxophone... Cornet... Trombone... Trumpet...
(Mention any other instrument interested in)
Name
Street Address
Town State



Red Devil PLIERS

THE "Red Devil" trade mark is a big thing to look for when you buy pliers.

It means all there is in pliers — that they are drop forged from tool steel, that they are designed and tempered with great care and skill, and will stand the test of hard use, —that they will serve well.

"Red Devil" Slip Joint Plier

For cutting wire, turning nuts, bolts, hanging picture frames; for the car, truck or tractor; for amateur plumbing jobs, etc. The thin nose gets into hard - to - reach places. Beautifully nickel plated. No. 924—6½ in., 60c a pair.

"Red Devil" Side Cutting Plier

About as useful a tool as any mechanic can own. The cutting edges cut and stay sharp—handles shaped to fit the hand without pinching. No. 50—6 in., \$1.25 a pair.

"Red Devil" Long Nose Side Cutting Plier

A most serviceable tool for adjusting the radio set; for stripping wires, etc. The long nose reaches inaccessible places. No. 654—6 in., \$1.30 a pair.

"Red Devil" Pliers are on sale at all dealers—if not in stock, send dealer's name.

Mechanic's tool booklet free



SMITH & HEMENWAY CO., INC.
Manufacturers of "Red Devil" Tools
264 Broadway New York, N. Y.

“RED DEVIL” PLIERS

Known and used
the world over.
Drop forged from
tool steel—made
in 100 styles—
for every need.



 This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

Mysterious Pencil Trick for Writing in Various Colors

By Kenneth B. Murray

YOU can have much fun demonstrating to your friends a pencil with which you can write in any colors—red, blue, green, purple, and so on.

The pencil itself is unprepared and can be handed around for examination. The secret lies in preparing beforehand several small patches of strong adhesive mending tape by gluing to the back of them bits of colored pencil "leads."

When demonstrating the pencil, secretly stick the patches of tape on several fingers of

the right hand. Then, as you use the pencil, it is necessary only to project a color tipped finger next to the point of the pencil, and write with the colored lead instead of the pencil lead.

The correct size to cut the adhesive tape is made clear in the accompanying illustration. The patches are instantly removable.

Using Old Vibrator Bridges

WORN-OUT vibrator bridges of Ford coils can be had for the asking at any garage and often prove handy around a shop. They serve as small braces on machinery or fittings, as spacers between parts, and the like.

Two other uses are shown. A vibrator bridge, a razor blade and two small bolts make an excellent scraper for removing paint from glass and similar purposes. If a more finished tool is desired, two bridges can be used, and a handle attached.

For feeding string from a ball over a store counter, the holes in a vibrator bridge offer just about the right amount of resistance. The ball of string is put in a box at any convenient location and the bridge attached to the box.—V. A. L.

Automatic Electric Fire Alarms

(Continued from page 133)

Where one of these alarms is expected to blow a whistle instead of sound a bell, the method shown in the lower right-hand corner of the illustration is effective.

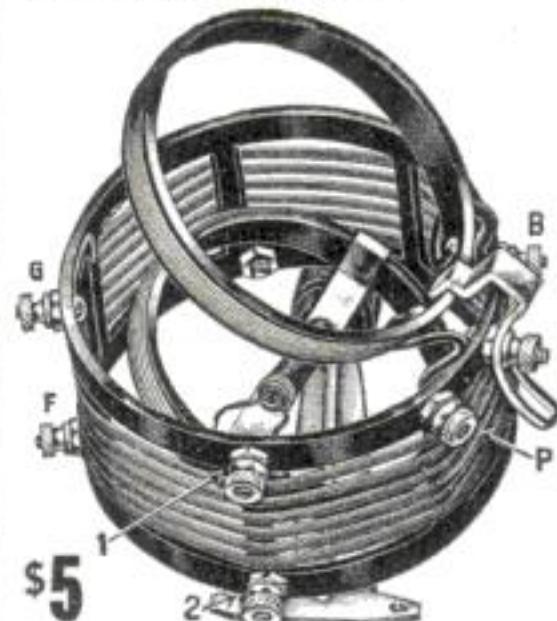
A pair of inverted magnets take the place of a bell. A flat iron armature with a round, vertical shaft rests below them in a run of two screweyes. The lower end of the shaft is attached loosely to a pivoted hook. A second pivoted lever is then placed in the hook. Over this lever is slipped a ring that is tied to a weight. As the circuit is completed by the automatic switch, the magnets attract the armature. This raises the hook and the lever drops, releasing the weight, which pulls the whistle cord.



Colored points stuck on the finger-tips

What Are Inferior Parts Costing You?

Just as much as you'd pay for Bremer-Tully parts,—the difference is in the results you get.



\$5
Two Types Short Wave 50 to 150 meters Broadcasting 200 to 565 meters

THE BREMER-TULLY LOW LOSS TUNER

This is not a trick tuner, but a standardized electrical instrument now in its third successful year. The unsurpassed results obtained by thousands of users has demonstrated the unquestionable superiority of this product.

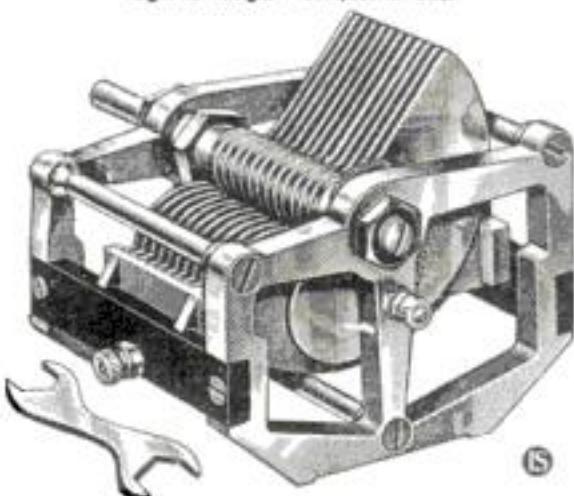
The untuned adjustable primary, the skeleton frame, the "Series Link" windings of the coils, are improvements of vital importance, insuring extremely low losses, greater selectivity, distances and volume.

No switches or taps are required, the bearing is adjustable, rotor is pig-tailed. All windings terminate in binding posts clearly marked. Single hole, panel or base mounting can be used.

The Short Wave Tuner Brings In the Low Wave Broadcasting Which Is Becoming So Popular

THE BREMER-TULLY "LIFETIME" CONDENSER

The Only Low-Loss Straight Line Wavelength Condenser. Light in Weight—Compact in Size.



150 M. M. F.	7 plates	- -	\$4.25
250 M. M. F.	11 plates	- -	4.50
520 M. M. F.	23 plates	- -	5.00
800 M. M. F.	35 plates	- -	6.50

"20 Point" folder gives you fuller details. Write for it.

BREMER-TULLY MFG. CO.
532 SO. CANAL ST., CHICAGO

Have you built the "nameless" circuit. Write us for folder.

Walnut Writing-Desk Converted into a Radio Cabinet

A N OLD writing-desk that had outlived its usefulness was converted into the radio cabinet shown simply by removing the pigeon holes and shelves from the interior.

There are several advantages in a cabinet of this type besides its cheapness and the fine appearance of the old walnut.



The set is hidden behind the desk doors

The slanting table top provides a comfortable rest for the arm while tuning the radio set, and there is plenty of room for the loudspeaker. The cabinet has ample space for the B battery and also for the A battery, if of dry cells.

The head phones, map, and other equipment are kept in one of the drawers. The storage A battery is placed on a shelf under the top of the table, just as a battery is held underneath a car. All the wires are run in from the back.

In this instance the cabinet was refinished after the old varnish had been removed, by giving it one coat of water stain, two coats of white shellac, each sandpapered lightly, and three coats of varnish, the last being smoothed with pumice-stone and oil.—G. C.

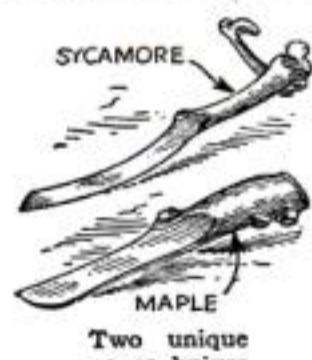
Cheap Emergency Cement for Filling Holes and Cracks

A CEMENT for filling corner crevices, cracks, and holes made by rodents, as well as for repairing wall breaks, can be made cheaply by mixing 1 part sand with 2 parts ordinary wheat flour and 1 part sifted coal ashes. These are stirred thoroughly and wet with water to a putty-like consistency.

The cement mixture is applied with a trowel. It takes three or four times as long to harden as Portland cement, but is durable and does not crack readily.

Paper Knives Whittled from Odd, Knubby Tree Limbs

NOW and again when wandering in the woods or along the road, knubby pieces of tree limbs are found, so odd that they tempt one to take them home. Some of them may be cut into unique and attractive paper knives.



Usually a knubby end may be trimmed a bit to form the handle and a projecting limb shaped like a knife blade. The back edge of the blade may be left quite thick. When the whittling and trimming are done, a little oil rubbed on gives a natural finish.—L. H.

Marvelous New Transformer



\$7.00

Our Slogan
"The Best
Transformer
Money Can Buy"

Amazingly Improved Radio Reception Or Your Money Back

UNLESS you can enthusiastically say: "I have never heard a radio give forth such pure, full, rich, round, pleasingly natural tones" we will promptly return the money you pay us for a pair of KARAS HARMONIK Transformers.

That's our special introductory offer! You are both Judge and Jury.

You will agree that the only criticism of radio reception at the present time is that the full beauty of music is lacking owing to the failure or inability of radio sets to reproduce and amplify the rich overtones and harmonics of sounds which are so necessary to really TRUE music. Up to now we have been receiving only a small part of musical tones—that's why voice and musical instruments sound so unnatural in a radio set. The NEW KARAS HARMONIK Transformers have changed all this by reproducing and fully amplifying entire tones—the harmonics and overtones equally with fundamental or primary tones.

You want the most perfect tone quality a radio set can possibly give you. So does everybody else. You want reception from a piano to sound like beautiful full toned piano music—not like the thin, stringy tones of a banjo. The new Karas Harmonik Transformers will give you such an unbelievable volume of delightfully pure music that you will be enthusiastically surprised.

You say "Prove this to me and of course I'll use your Transformers". To prove it to your entire satisfaction is exactly what we propose to do by

our unconditional money-back guarantee. Over a year ago our Engineers set out to design and develop an Audio Frequency Transformer that would raise the quality of radio music and speech to an entirely new plane. It has taken a year of intensive hard work and the expenditure of many thousands of dollars to do this. But now the new KARAS HARMONIK Transformer is a reality and available for you to use and enjoy. Our transformers are being sold through regular jobber and dealer channels but it takes time to effect complete national distribution. If your dealer has our New Karas Harmonik Transformers in stock he is authorized to extend our offer to you. If he hasn't yet had a chance to secure a supply, you may order direct from us in accordance with our special introductory offer backed by an unconditional guarantee that enables you to try out and prove these new KARAS HARMONIK Transformers without risking one penny.

Here's the Offer We Make You

Just fill in and mail the coupon below and we will send you a pair of the new Karas Harmonik Audio frequency Transformers to take the place of the Transformers now in your set or put in that new set you are building or are going to build. When the Transformers arrive you hand the postman \$7.00 for each Transformer plus a few cents postage. Put the Transformers into your set and use them for 60 days. Put them to every test you can devise. Then if you do not decide that the quality of musical reception of your set is vastly improved you are free to return the Transformers and we will cheerfully return your money immediately without question or quibble.

KARAS ELECTRIC CO., 4040 N. ROCKWELL ST. DEPT. 13-68 CHICAGO

To Jobbers and Dealers.

Distribution of Karas Harmonik Transformers through regular jobber and dealer channels is being carried out as rapidly as the output of our factory permits. In the meantime mail applications will be taken care of in the order they are received, on an allotment basis. Write us for test records, discounts, etc.

To Set Manufacturers.

We positively prove that Karas Harmonik Transformers will vastly improve the musical quality of your set by any form of test you wish to impose. When you are convinced of this you will naturally want to use them. Write or wire us and arrangements for tests will be made promptly.

Karas Electric Co., Dept. 13-68

4040 N. Rockwell Street, Chicago, Ill.

Please send me pair of Karas Harmonik All Stage Ratio Audio Frequency Transformers. I will pay the postman \$7 a piece, plus postage, on delivery. It is understood that I am privileged to return the transformers any time within 60 days if they do not prove entirely satisfactory to me, and my money will be refunded at once.

Name.....

Address.....

City.....

If you send cash with order we'll send transformers postage prepaid.



KLEIN PLIERS

Of course, the skilled mechanic and the professional electrician may have more pliers in his kit.

But, for the man who works with tools for the pleasure he gets out of it, three pairs of Klein's will serve most of his purposes.

A pair of 8 inch Klein's Side Cutting, one pair of 6 inch Klein's Oblique, and a pair of 6 inch Klein's Long Nose fill the bill.

Your hardware dealer carries a full line—look them over next time you are in.

Just ask for Klein's!

Klein's "Pocket Tool Guide" is full of useful tables for the electrician. Drop us a card for one. It's free for the asking.



3220 BELMONT AVENUE
CHICAGO, ILL.

Mathias & Sons **KLEIN**
Established 1881 Chicago, Ill., U.S.A.

(S) This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

The Shipshape Home



Overhauling Your Heating Plant

WELL, that's settled for the winter," a friend of mine remarked with visible relief as the last bucket of a 15-ton consignment of coal rattled down the chute into his basement. "Last year I bought only 10 tons, thinking that would do, and had a hard time getting five additional tons when I found I needed them. I am taking no chances this fall."

"You don't mean to tell me you burn 15 tons of coal to keep this house warm?" I asked in surprise. He assured me he did.

As a heating engineer I knew something must have been wrong, because the house apparently had an adequate heating plant, was snugly built, and did not have an excessive amount of window surface.

"Let's look at your furnace," I suggested. "There must be something radically wrong with it."

We went into the basement and at first glance I was more puzzled than ever. It was a steam plant and, while not new, of a very good type. It appeared to be in excellent repair, but still I knew something must be wrong, so I opened all the doors and looked inside. The mystery of the coal consumption then was solved. The furnace was so dirty that it was impossible to heat it without wasting coal. I found the flues almost plugged up with soot. The top of the boiler was covered with soot and ashes and the smoke pipe was half clogged.

"That's where your coal went," I told him, pointing to the accumulation of soot in his flues and pipes. "Clean that out and see what a difference it makes."

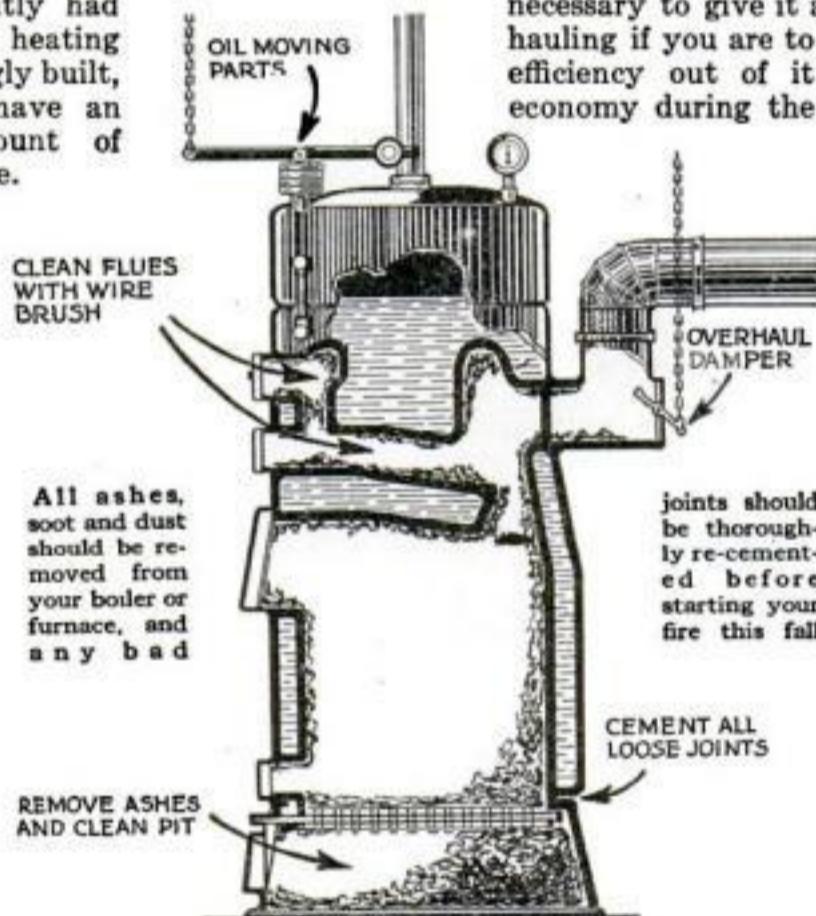
My friend promised to have a man in at once to clean out his furnace and I feel confident that if he does so he will have five of his 15 tons of coal left when he lets out the fire next spring.

By Orion O. Oaks
Heating and Ventilating Engineer

It isn't necessary, however, to "call in a man" to clean out a furnace. You can do it yourself with very little trouble. To overhaul the entire heating plant should not take you more than half a day, even if you have no marked mechanical ability. This is true of hot-water, hot-air, or steam plants.

The careful furnace man will overhaul his plant in the spring and then go over it again in the fall; but assuming that you let your fires go out when the warm weather set in and then, as most of us do, forget about the furnace until it came time to light it up again, it will be necessary to give it a thorough overhauling if you are to get the greatest efficiency out of it at the greatest economy during the cold weather.

Start at your chimney. Take down your smoke pipe and brush it out thoroughly. When you replace it, be sure it makes tight joints where it is attached to the furnace proper and where it enters the vertical chimney. Also be sure it does not protrude in-



to the chimney area, because, in case it does, it will cut off part of the draft. The cleaning of the smoke pipe should be the same on hot-water, steam and hot-air furnaces.

For hot-water and steam plants the next step is to open the draincock and allow the water to run out until it runs clear. If the water does not run clear after a few pails are withdrawn, the indications are that the boiler contains considerable sediment. In this event it should be emptied and thoroughly flushed by alternately attaching a hose to the draincock and running in water from the house supply and removing the hose to let the water run out. When the boiler is cleaned, fill it again to the proper level, closing the draincock, of course. The proper level for most boilers is indicated

when the water in the gage glass is about halfway up.

Examine your boiler thoroughly and make certain that all cemented joints are in good condition, and that no cement has become loosened or fallen out.

In some boilers of the sectional type, furnace cement is used to make tight joints between the sections so that there will be no short circuiting of the burning gases, which would allow them to enter the smoke pipe and go up the chimney without first having completed their travel through the passages of the boiler. Expansion and contraction sometimes loosen this cement and if the joints are not made tight by re-cementing, considerable heat will be wasted and the boiler will not perform in a satisfactory manner. You can get furnace cement at almost any hardware store.

This same method of making tight joints is used in other parts of the boiler such as around fire, ash-pit, and clean-out doors, also where the boiler rests upon its base. These points should receive careful inspection and attention if economical operation is desired.

Inspect all vent valves in the basement and on radiators to ascertain that the openings are not closed by corrosion. Test all radiator control valves and renew the steam packing if necessary, thereby preventing leakage and possible damage to floors and ceilings.

Overhaul the damper regulator and other mechanical devices, making sure that they are clean and all moving parts free from rust and in proper adjustment. If a thermostat is in use, it will be profitable to have this inspected, cleaned, and adjusted by a competent thermostat installer. The charge is not great and well worth while to insure the subsequent reliable operation of this part.

The foregoing applies alike to steam, vapor, and hot water, with the exception that a hot-water system is filled completely to the expansion tank above the highest radiator, or special instructions are followed in the case of the "closed system."

CLEAN BETWEEN SECTIONS WITH RADIATOR BRUSH
PACK VALVES
Valves should be inspected and all the radiators well dusted

All steam or vapor systems are provided with some type of damper regulator for controlling the steam or vapor pressure by operating the drafts; many hot-water systems are without such devices, however, for the reason that the best types are controlled by patents.

One further point is the thorough cleaning of all radiators between the

(Continued on page 138)

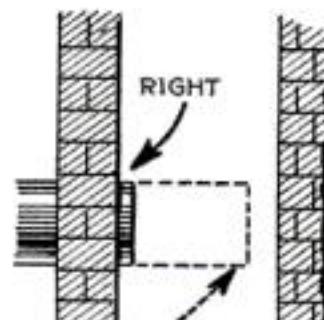
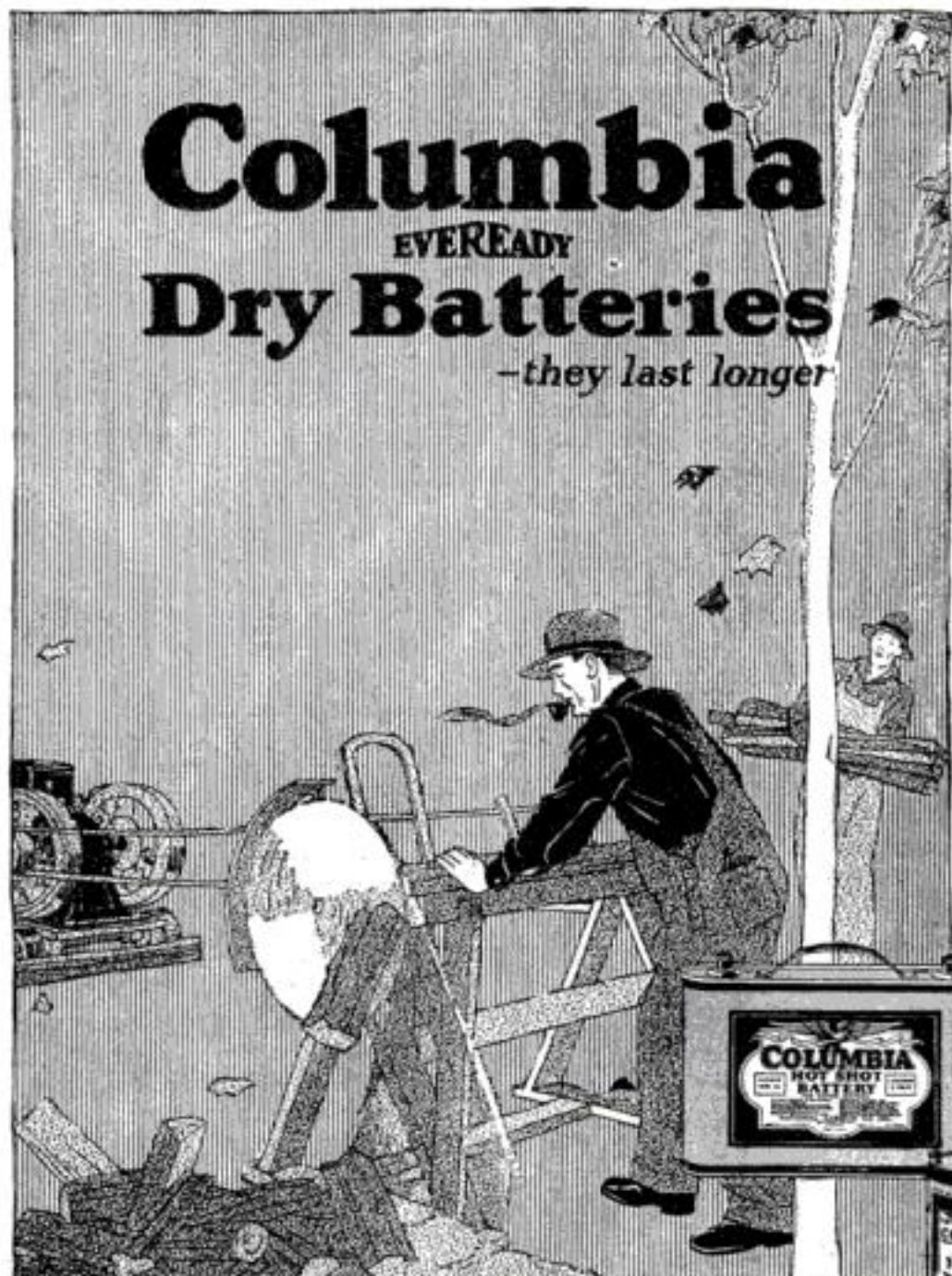


Diagram showing projection of smoke pipe into chimney

Concentrated energy— rarin' to go



Columbia Hot Shot contains 4, 5 or 6 cells in a neat water-proof steel case.



POWER and pep set on a hair trigger, that's what the Columbia Hot Shot brings you. Hitched to a gas engine these electrical huskies hop on the job instantly. Their fat, hot sparks explode the whole charge, bringing to the work power that makes saws zip through the heaviest logs. For farm and mine and camp; at home and afield, Columbia Eveready Dry Batteries are ever-ready to put their last ounce of energy into the job.

When idle, Columbia Evereadys do not fret away their strength. Resting, they renew their energy and store up fresh pep to zip through the circuit at the word "go."

Don't just ask for "a dry cell." Ask for "Columbia Eveready" by name and get 100% battery efficiency. Columbia Eveready Dry Batteries are sold by implement dealers, electrical, hardware and auto accessory shops, radio and marine supply dealers, garages and general stores—Columbia Eveready Ignitors can be purchased equipped with Fahnestock Spring Clip Binding Posts at no extra cost to you.

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for

- gas engine ignition
- telephone and telegraph
- doorbells
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- motor boat ignition
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- tractor ignition
- starting Fords
- ringing burglar alarms
- protecting bank vaults
- electric clocks

- calling Pullman porters
- firing blasts
- lighting tents and outbuildings
- running toys
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Can you look at this tool and not want it?

WE dare you to let your hardware man show you this Millers Falls Spiral Ratchet Screw Driver No. 61.

With three blades and three ways of working, it does everything a screw driver can. It's new, it's a Millers Falls tool—it does its work better than it was ever done before. It's about as useful—and handsome and valuable and generally interesting—a tool as you could own.

You men who use tools—professionally or on the side—pick up one of these in the store. And then try not to buy it.

Meet the new members of the family—with the Automatic Return

No. 61 has two brothers—No. 62 (larger) and No. 67 (smaller). The new cousins—Nos. 610, 620, 670—correspond in design, with the addition of a spring in the handle. With this extra feature of automatic return they work like an automatic drill—life-savers for "one hand" jobs. You don't have to hold the chuck. Special chuck and drills can be furnished for drilling small holes.



Here's what you see when you examine No. 61 and his family

A beautiful tool in design and finish. Highly polished on smooth surfaces; good knurling where needed.

Three actions—right or left spiral; right or left ratchet; plain screw driver.

Three blades—easily inserted, with positive lock; easily removed.

New and unique design of shifter for right and left spiral or rigid action. Quick and positive action.

Locking collar on shoulder of spiral makes it a ratchet screw driver.

Can you beat all that?

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Millers Falls, Mass.
28 Warren St., New York
9 So. Clinton St., Chicago

Manufacturers of Mechanics' Tools, Hack Saws and Automobile Tools

MILLERS FALLS TOOLS
SINCE 1868

The Shipshape Home

(Continued from page 137)

sections, using a narrow brush made for the purpose or the narrow tool of the vacuum cleaner. During the summer dust lodges in these portions of the radiators. If not removed it is thrown up and out into the room by the warm currents of air flowing up through the heated radiator. This causes the "smell of heat" when the system is first fired up.

When the above suggestions have been conscientiously followed, the apparatus is ready to deliver a season of satisfactory and economical service.

For hot-air furnaces it is advisable to remove the outer casing of the furnace and clean the air-heating surfaces of all accumulation of dust and dirt, also the space at the bottom between castings and casing. Inspect the cemented joints by which the various sections are made tight, remembering that the principle upon which the warm-air furnace operates is the passing of fresh air over heated iron surfaces. If by any chance the products of combustion are allowed to escape into the air chamber, a mixture of the two is delivered into the rooms with consequent annoying, if not serious, results. Inspection and re-cementing of any such joints found defective will insure the delivery of clean, warm air. This applies to the so-called pipeless as well as pipe furnaces.

After the furnace is inspected, all floor registers should be removed and the register boxes thoroughly cleaned, as dirt is likely to collect in these boxes and be discharged into the rooms when the furnace is started.

The fresh-air inlet, commonly called the "cold-air box," should be thoroughly cleaned so that accumulated dust will not be drawn into the furnace. The fresh-air inlet screen should be inspected to see that it be not choked with rubbish.

At intervals of a few years, the horizontal hot-air pipes should be taken down and cleaned, as dirt also collects in these pipes; though not as rapidly as in other portions of the system.

Some of these suggestions may appear superfluous, but from a long and varied experience in the heating industry, it is my opinion that the foregoing practice of attention and inspection assures the greatest heating comforts, guards against winter repairs, which are both costly and annoying, and returns the expenditure of effort or money in prolonging the useful life of the heating system.

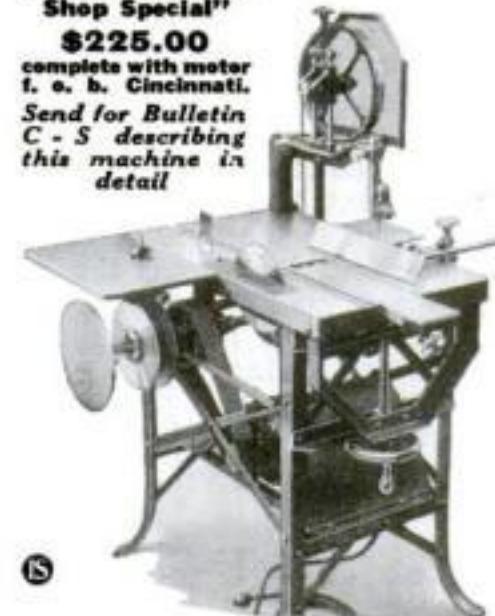
Wallpaper Spots

IN MY experience as a paperhanger in the last 12 years, I have found the best way to cover a grease spot on a wall or on old paper before putting on new paper is to use a piece of tinfoil such as is found wrapped around cigarettes. By pasting it over the grease spot before applying the paper, the spot will be stopped permanently from showing through.

As a rule, paperhangers scrape the grease spot off, digging right into the plaster, and then fill up the hole, but this makes quite a bit of dirt and, of course, takes much longer.—CHARLES E. MOEHLER, Johnstown, Pa.

Parks "Cabinet Shop Special"

\$225.00
complete with motor
t. o. b. Cincinnati.
Send for Bulletin
C-S describing
this machine in
detail



The biggest little woodworker ever built!

You'll want this sensational Parks combination woodworker right away for your shop—includes 8-inch rip and cross-cut saw, 4-inch jointer, band-saw, borer, shaper, sander, and universal motor. Complete with lathe attachment only \$225.00. First-class Parks angle-steel construction, all joints electric-welded. Steel table-top. The newest thing in small shop equipment. Guaranteed 10 years.

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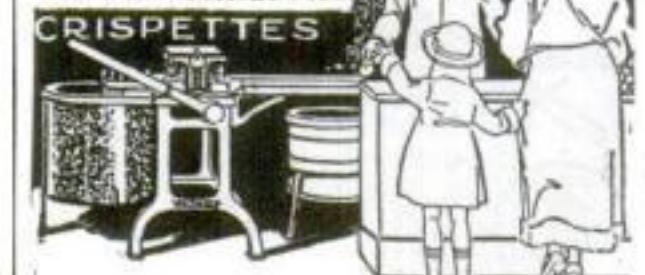
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The Shipshape Home

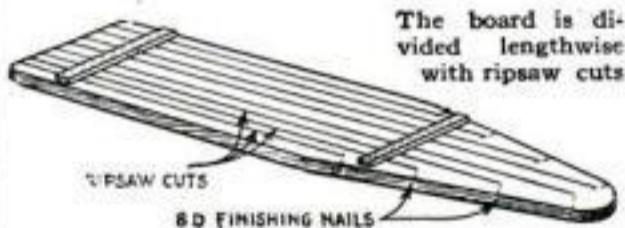
(Continued from page 138)

To Straighten Ironing-Board

HERE is a home workshop stunt that I did for my wife the other day, and one that will be useful, no doubt, to many another housewife:

Her own ironing-board, which is of the solid board type, had warped so badly that she hardly could use it. I removed the covering and padding, took the cleats from the under side, and drew lines along it 1½ in. apart.

With a ripsaw, I cut down on each line, starting at the large end and continuing



to within 3 or 4 in. of the other end. To keep the cuts from splitting at some future time, I drove finishing nails across the end of each cut, as indicated. The cleats then were nailed securely in place without closing the saw cuts, after which the padding and covering were refastened.

The board now is free from warp and perfectly smooth. It cannot very well twist again because the steam from the iron escapes through the saw cuts and each strip is too narrow to be affected very much.—H. T. SHRUM, Oshkosh, Wis.

Using Sandpaper

MUCH as sandpaper is used in keeping the home shipshape, a good many amateur mechanics either do not handle it properly or waste an unnecessarily large amount. Good sandpaper gives a surprising amount of wear and it is often thrown away before its usefulness is over.

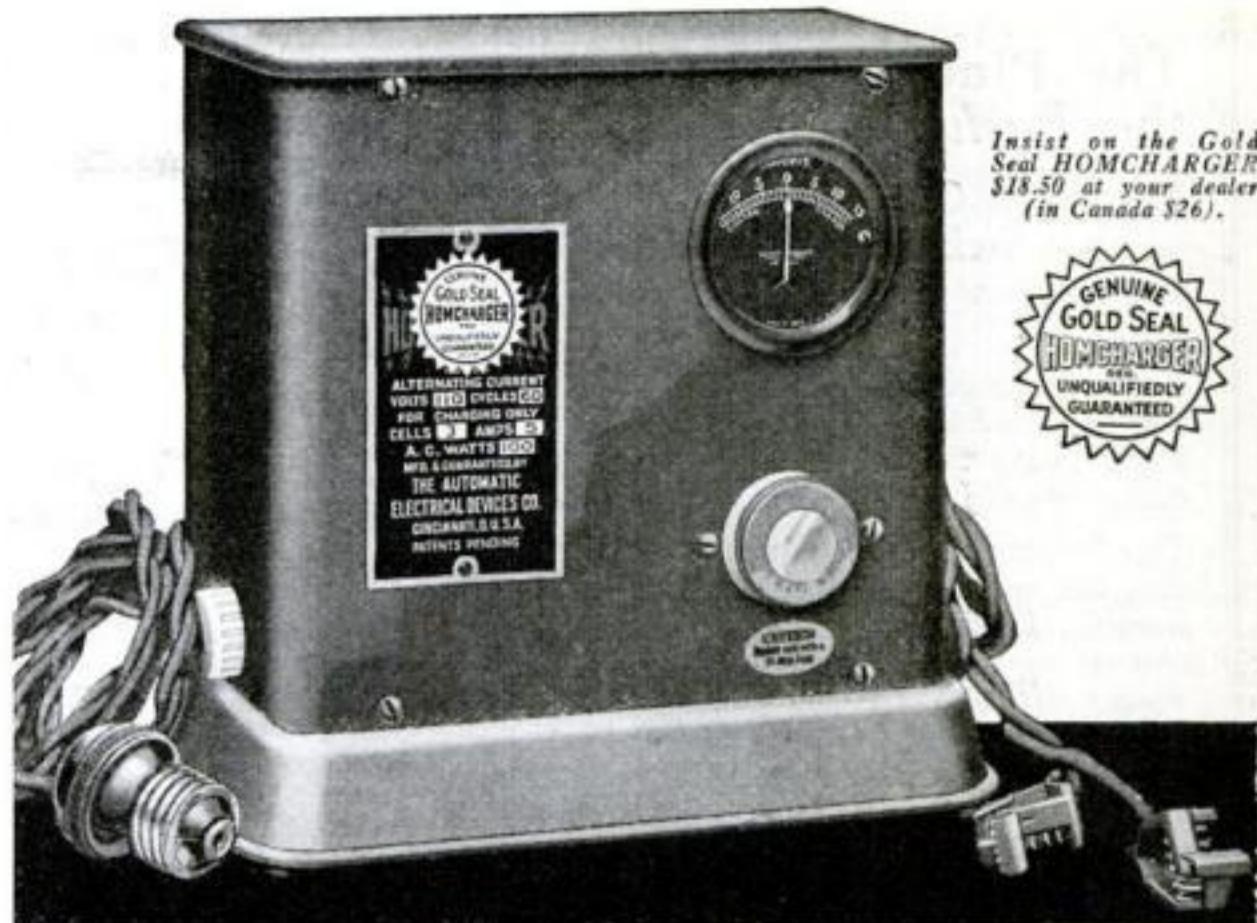
Dust and gum, which fill in between the grits, can be removed by snapping the paper forcefully against the work or the top of the bench. Turning the paper around on the block also prolongs its life because new edges of the gritty abrasive are presented to the work in each position.

Ordinarily, for flat work, the paper is held around a block of wood, leather, or rubber. Moldings and carved or odd shaped work can be rubbed by wrapping the sandpaper around a short length of molding, a shaped piece of wood, or a folded wad of corrugated paper.

To divide sandpaper into convenient sizes, bend it over a sharp edge several times and then tear it apart.

It goes without saying that all sandpapering should be done with the grain if the woodwork is to have a natural finish. In sandpapering woods prior to painting, however, it is advisable to rub across the grain. If there are any soft, spongy parts to be sandpapered, it is well to give the surface a thin coat of glue size, which, when hard, will bind the fibers together.

Another point is that certain grades of sandpaper are recommended for soft woods and others for hard woods. It is advisable for the home worker who does much woodwork to keep on hand fine, medium, and coarse sheets of each kind.



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- 10—Beautiful; sturdy metal case finished in mahogany-red and gold.
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Everybody says this is the handsomest charger ever seen. The Gold Seal Homcharger is finished in mahogany-red and gold. It has rubber feet and so cannot mar polished floors, tables or cabinets. Safe—approved by the Fire Insurance Underwriters. Can't injure anything.

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FREE! Ask your dealer or send direct for our interesting free booklet, "The Secret of Distance and Volume in Radio," containing valuable information on this subject and fully describing the GOLD SEAL HOMCHARGER.

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There's but one kind of record that the operator is anxious of showing, or the inventor is intent on making. That's an obviously *HIGH* record—and going *higher!* That's what's recorded at any machine with a

Veeder COUNTER

This small Rotary Ratchet Counter (No. 6) counts reciprocating movements of the lever, as required for recording

the output of innumerable small machines. When the lever is moved through an angle of 40 to 60 degrees, the counter registers one. The further the

lever is moved, the higher the number registered. A complete revolution of the lever registers ten. This counter can be adapted to no end of counting purposes, by regulating the throw of the lever. Price, \$2.00 (Cut nearly full size.) Small Revolution Counter, also \$2.00

The Set-Back Rotary Ratchet Counter below is for machines such as presses and metal-stamping machines, where a reciprocating movement indicates an operation.



Registers one for each throw of the lever and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figures, as illustrated, \$11.50—subject to discount. (Cut less than $\frac{1}{2}$ size.) Set-back Revolution Counter of similar model, \$10.00 (list).

Send for the 80-page Veeder booklet, and see how to put the "push" behind YOUR machines.

The Veeder Mfg. Co.
44 Sargeant St. Hartford, Conn.

What You Can Do with Your Bench Vise

By George A. Luers

Mechanical and Automotive Engineer

JOHN BARROW, a neighbor of mine in the suburbs, never appreciated the real value and utility of the bench vise in his basement workshop until one cold and blizzardly night. In making up the furnace, he broke the flange connecting the back stack.

The part evidently had been fractured before, but now it parted entirely and repairs had to be made immediately.

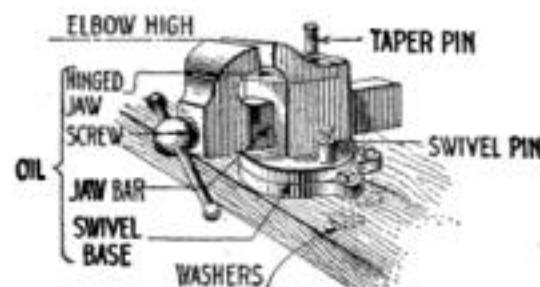


Fig. 1. A typical vise of the machinist's type and points where it should be oiled

Otherwise an uncomfortable night would be spent and there would be the possibility of frozen and damaged water pipes and heating equipment.

The pipe was held with a temporary prop while the materials for repair were sought. Some long pieces of strap iron were uncovered in the junk pile. These were bent and twisted by means of the vise and then were drilled and installed to form a secure collar about the stack. These repairs held and continue to hold.

The owner of a bench vise never realizes, except on an occasion like this, how invaluable the equipment really is. A medium or moderately heavy vise of

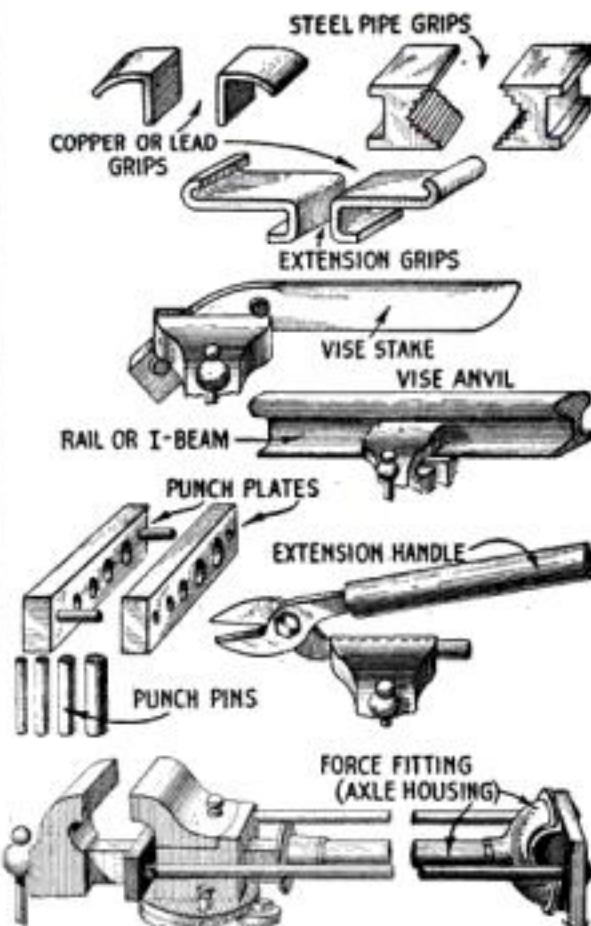


Fig. 2. Vise grips, vise stake and anvil, punch plates, shears, and extension plates

the machinist's type, with 4½-in. jaws, weighing about 40 lbs. with a hinged back jaw and a swivel base, is my own preference for all-around utility.

(Continued on page 141)

THAT WET BOILER PIT CAN BE MADE DRY!

MAKE and keep your cellar walls, floor and boiler and drain pits thoroughly dry by filling the cracks and coating the surface with Smooth-On No. 7, the only practical waterproofing material that can be effectively applied from inside and bonds perfectly on wet or dry surface. Excellent also for patching concrete floors, waterproofing garage, stable and wash-room floors, brick walls, cisterns, septic tanks, water troughs, fountains, fish ponds, swimming pools, manure pits, etc.

Requires about 25 lb. Smooth-On per 100 sq. ft. of surface and you can do the work yourself.

Sold in 5 and 10-lb. cans
and 25, 50 and 100-lb. kegs

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This FREE "B" Storage Battery takes the place of dry cell "B" batteries. Can be recharged and will last indefinitely. To be sold retail for \$5.50. It is the only battery of its kind equipped with solid rubber case—and insurance against acid and leakage. Take advantage of this remarkable introductory offer NOW. (To those who prefer it, we will send FREE a handsome nickel finish Auto Special, instead of the "B" Battery. Be sure to specify which is wanted.)

GIVEN FREE

To introduce this new and superior World Storage Battery to the public.



Your Bench Vise

(Continued from page 140)

The base should be bolted solidly to a 2-in. oak- or maple-top bench, because of the strain of bending, twisting and hammering. The best height is to have the jaws even with the elbow, when standing, forearm extended. The bolts should extend through the bench and have washers under the heads at the wood.

There are four places to oil a vise—the screw, the slide, the hinged jaw and the swivel base, and these should have occasional attention (Fig. 1). If neglected, the screw will loosen, the movable jaw twist, and the base become unsteady. When the screw turns, yet the jaw requires to be pulled out by hand, the vise has been neglected.

While many amateur mechanics use the vise for a variety of work, others are not aware that it will serve in an emergency for a number of purposes, including anvil

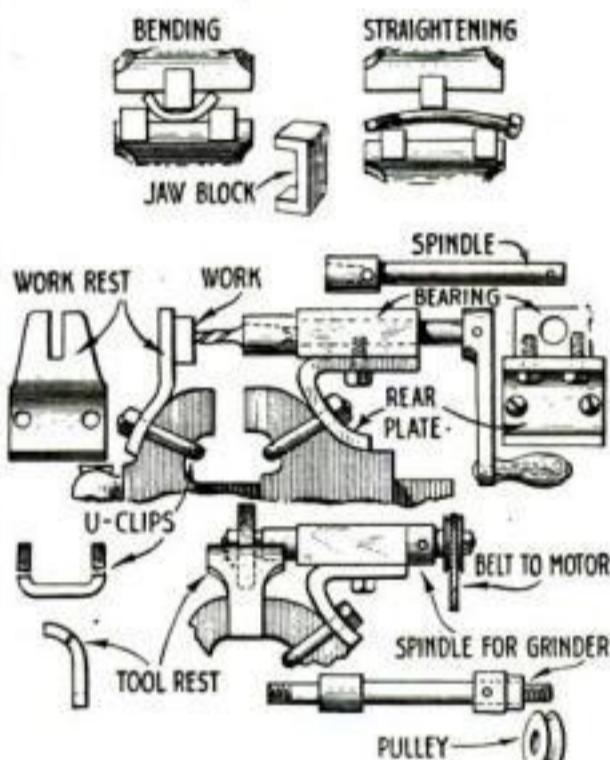


Fig. 3. Vise blocks for bending and straightening and special fixtures for drilling and grinding

use, bushing work, belt fastening, cementing, clamping, drill work, holding work for saw, hand reaming and tapping, chipping and filing (parts held in vise), pressing forced parts, punching, pipe gripping, setting split and tubular rivets, shearing sheet metal, bending and straightening plate and bars, and holding a grinding fixture.

In some of these uses it is necessary to have a special rigging or attachments, typical of which are the devices mentioned below:

Vise Grips. In Fig. 2 are shown three vise grips—soft jaw grips of lead or copper, corrugated or pipe grips, and extension grips for parts exceeding in length the opening of the vise jaws.

Stake and Anvil. Two desirable anvil fixtures also are shown. One is a stake that rests on the vise jaws for tubular work, as pipe seams, cylindrical parts, and sheet-metal work. The other is a vise anvil made either of a section of rail or an I-beam about 2 ft. long. This is used for straightening rods and shafts and doing riveting work. If desired, the ends of the anvil may be rounded or pointed for convenience.

(Continued on page 142)



Does Not Warp!

Resists the Most Rigid Tests

HEAT and weather changes, that play such havoc with rubber, are powerless to affect Spaulding Bakelite-Duresto panels which have never been known to warp, shrink nor split.

Highest in dielectric properties, and tensile strength, these panels saw, drill, engrave without chipping—retain indefinitely a beautiful mirror finish—all made possible by the special Spaulding process of fabrication.

Insist on Bakelite-Duresto. Your dealer can furnish standard sizes from stock, special sizes to order. For a sign of quality apparatus, look for Spaulding Bakelite-Duresto panels in each set you buy.

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Simple Modification Improves Ordinary Pen or Pencil Clip

WHILE stooping over a brook to watch some small fish not long ago, I lost a highly prized gold lead-pencil, which had been given to me by a relative. I did not miss it until I reached home; then, in order to cover up the loss, I bought an exact duplicate. It was only a week after that I lost this one also. Several of my friends have told me since of their difficulties in keeping fountain pens and pencils.

The trouble is that the clip does not grip tightly enough at the critical moment. This can be overcome, I have found, by filing a slight groove, as shown, in the pencil or the fountain-pen cap, for the ball at the end of the clip to slip into.—P. A. DASCHKE.

Your Bench Vise

(Continued from page 141)

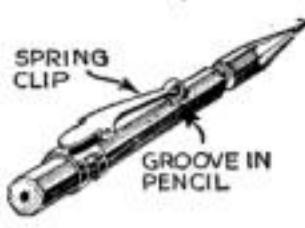
Punch Plates and Shears. These tools are convenient for heavy sheet-metal work. The punch plates are simply two steel plates held with loose dowels. The punch holes, which are graduated in size, are drilled to coincide in the opposite plates and the punch is pressed through with the vise. The shearing device is a pair of heavy metal shears arranged with an extension handle of pipe, the other handle being gripped in the vise. An old pair of cutters may be converted to this use, in which case it is well to drill for a larger pivot bolt.

Bending and Straightening. For this purpose three small jaw blocks as shown in Fig. 3 are used. These are placed as needed to bend parts to a U shape or to take out a kink.

Drill and Grinder Head. This special fixture (Fig. 3) may be purchased as part of the vise equipment, or it can be made up by the vise owner if he so desires. It is made mainly of iron plate. The rear section forms a bearing for a toolholder that has an attached hand crank. The rest section, which is fastened to the movable vise jaw, supports the work. The work is fed into the drill by means of the vise screw. Heavy drilling can be done with this tool. The grinding attachment utilizes the fixed rear bearing for carrying a spindle with pulley and emery wheel. The grinder head is connected with a small motor by a leather belt.

Extension for Vise Bar. Parts too long and large to handle in the vise jaws for work such as pressing on gears or bushings, can be handled behind the vise bar. This is accomplished by extending two rods with plates at each end, as in Fig. 2. One plate engages the solid part of the vise, while the rear plate serves as a rest for the work. Any available long threaded rods and drilled plates will serve for this purpose.

A study of the various vise tools shown will suggest other equipment that can be made. The vise has well been called the mechanic's third hand.



A groove is filed for ball of clip fastener



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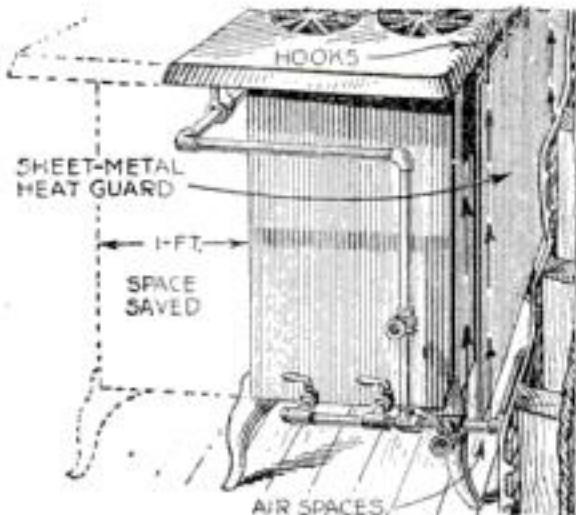
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Sheet-Metal Heat Guard Saves Space in Small Kitchen

KITCHENS in modern homes are seldom any too roomy, and the necessity of installing a gas range far enough away from the wall to prevent danger from fire, does not increase the floor space.

In the writer's own home the gas range had to be set out nearly 15 in. from the wall in a very small kitchen. This so decreased the floor area that the kitchen was an aggravation.

Seeking some means of setting the stove closer to the wall, I devised the heat guard



This guard made from a sheet of iron allows the gas range to be placed close to the wall

with two heat-absorbing air spaces shown in the accompanying sketch. It permitted moving the stove to within 3 in. of the wall.

The increased floor area relieves the kitchen of its former inconvenience. Moreover, the heat guard with the air spaces created by it, so completely absorbs the radiated heat from the oven that the plaster wall behind the stove is only slightly warm even when protracted baking operations are being done in the oven.—JOHN E. HOAG, Los Angeles, Calif.

Glue Brush Made of Basswood

TO MAKE an everlasting hot or cold glue brush, select a piece of clear, straight-grained basswood about $\frac{1}{4}$ by 1 by 12 in. Soak about 3 in. of one end in a can of water for a few days. If the water can be kept hot by placing the can on a stove or furnace, the process of separating the fibers will be hastened.

When the wood has been soaked well, lay the wet end on some hard, smooth, solid article, as an anvil or bench, and pound it with a mallet. Do not hit hard enough to break the end fibers, but just enough to loosen them.

Return the brush to the water and allow it to soak again for a day or so; then remove and pound again. Repeat as often as necessary until the fibers are separated. They will be as fine as the bristles of a good varnish brush.

These "bristles" will not burn when the glue is hot. They will wear off in use, but the fibers become loosened farther up the handle as the brush is worn, which keeps a continuous mass of bristles as long as there is a handle. If the brush is laid aside accidentally and becomes dry, do not try to bend the bristles; soak them in water for a while and the brush will be as good as ever.—I. H. C.

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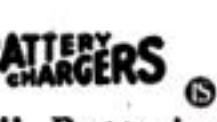
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Simple Laying-Out Tool Aids the Home Machinist

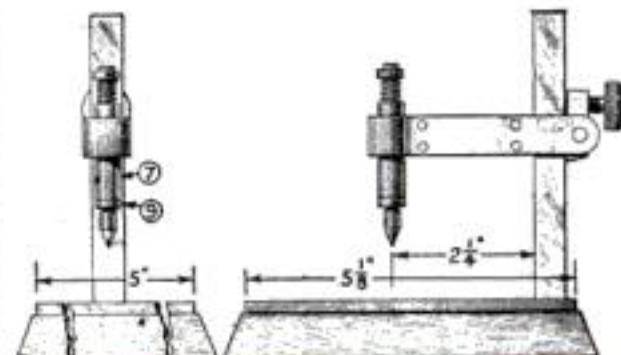
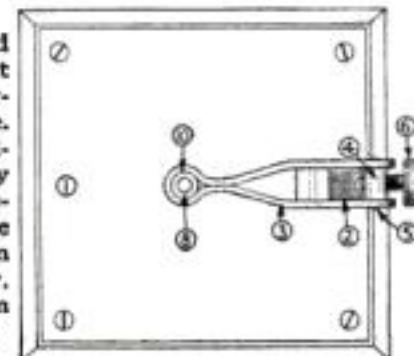
By Howard Greene

FOR home machinists and others who do accurate mechanical work, the little tool illustrated is an aid in doing good work in the quickest and easiest way. It consists of a center punch, or prick punch, mounted in an adjustable arm that projects over a table.

The punch works in a guide and normally is held up by a light helical spring. In use, the point of the punch is brought as close as possible to the work by adjusting the arm, and the punch is struck a light blow with a small hammer, after which it automatically returns to its position just clear of the work. The dimensions given are those of a machine that has been used for many years with satisfaction; but it is obvious that they can be varied in many ways.

The base or table (1) is of $\frac{3}{16}$ - or $\frac{1}{4}$ -in. cold rolled steel 5 by $5\frac{1}{8}$ in., and

Top, side, and condensed front views of the laying-out machine. The punch is adjusted as closely as possible in relation to the work and then struck lightly, thus insuring an accurate mark



the post (2) of $\frac{1}{2}$ -in. square cold-rolled steel $4\frac{1}{2}$ in. high above the table, is set into it, clearing the back edge by $\frac{1}{8}$ in. One end of the post is shouldered down, preferably but not necessarily in the lathe, to $\frac{3}{8}$ in. and fitted tightly into a hole drilled in the plate. The hole is countersunk at the bottom and the end of the post is riveted and then filed off flush. The main thing is to see that the post is set solidly and stands perfectly square. The plate is screwed to a $\frac{3}{4}$ -in. hardwood base.

The arm (3) is made of $\frac{1}{8}$ by $\frac{5}{8}$ in. cold-rolled steel, which is bent around a brass tube and riveted as shown, so that the tube is clamped hard and fast. The bending is best done hot. The steel is spread toward the back and a brass block riveted in to bear against the post. Make a close fit against the sides of the post. The ends are carried back to form lugs between which is pivoted the clamping block (4), which is of cold-rolled steel $\frac{3}{8}$ by $\frac{1}{2}$ in. and $1\frac{1}{4}$ in. long.

The pivot (5) is a piece of $\frac{1}{4}$ -in. steel rod, with the ends riveted over after assembly. The clamping screw (6) is $\frac{1}{4}$ in., preferably with a thread of fine pitch.

(Continued on page 145)

Simple Laying-Out Machine

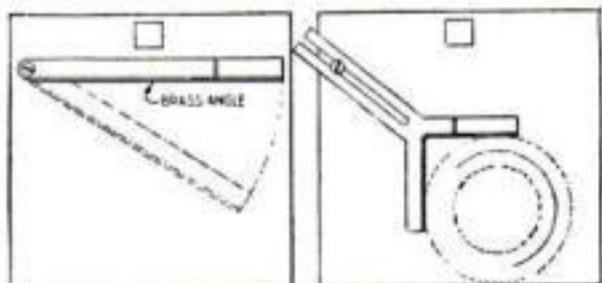
(Continued from page 144)

The brass tube (7), through which the punch plays, should be of the heavy-walled kind; it should have walls at least $\frac{1}{8}$ in. thick. The exact diameter is not important, nor is that of the punch itself. The punch (8), however, should slide freely but with no shake.

A brass collar (9), pinned on below the tube, limits the upward movement of the punch, and a similar collar (10) near the top takes the spring pressure. Drill the holes for the collars before hardening the punch. Give the punch point a long, sharp taper and see that the point is exactly in the center.

Using this tool is like having a third hand; the workman has his hands free to hold the work and wield the hammer, which, by the way, should be light, as the tool is not intended for heavy work.

For straight work, it often is convenient to use a guide. This is clamped to the plate by a screw that allows it to be



Brass angle used as straight guide, and an angular guide for setting cylindrical work

swung around, bringing it to within any desired distance of the center.

If it is desired to make a row of marks all the same distance from the edge of a plate, set the guide so that it comes to within that distance from the center of the table, clamp it, and then the work can be slid along and punched at the desired intervals. The easiest way to set the guide is to set a pair of dividers to the distance the holes are to be from the edge, scribe a little arc on the table from the center, and swing the guide until it is just touching and tangent to the arc.

The center of the table is marked by bringing the arm down and marking with the punch.

Round work can be handled conveniently with the aid of an angle guide. If a cylindrical piece is put into the angle guide, and the guide set so that the point of the punch will come over a point, say $\frac{3}{8}$ in. from the outside, then by turning the piece in the guide a ring of marks can be made all exactly the same distance from the outside, and perfectly concentric with it. This is often of great value.

For a job that stands high the arm can be raised, and vice versa. If one is likely to have high jobs, the post can be made longer at the outset. Work of irregular shape can be put into a drill-vise, or clamped between the jaws of a machinist's clamp.

By holding the punch down with one hand and moving the work with the other, the tool can be used for scribing. In fact, there are a hundred and one things that can be done and any one who makes the tool will think of plenty of them. The more this simple laying-out tool is used, the more ways will be discovered in which it can be used.



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Use a 4- or 8-oz. bottle and pour in the tears of gum until it is about one-fifth full. Then add the alcohol, filling the bottle to within $\frac{1}{2}$ in. of the top. Shake up thoroughly and add a tablespoon of ozonized turpentine for each 4 oz. of varnish made.

The alcohol and turpentine mix without difficulty and produce a clear solution slightly yellow in color, due to the gum. If ordinary turpentine, which really is spirits of turpentine, is used, then it will be impossible to mix the alcohol and the turpentine. The solution will become cloudy and the varnish can not be used.

Shake up the varnish occasionally until all the gum possible has



been taken up by the alcohol. If all the gum has dissolved, add more of it, and if some still remains undissolved, let it stand. Let the varnish settle for 24 hours, when all small fragments of bark and dirt will have settled on the bottom. The perfectly clear liquid is now ready to use.

This is an excellent varnish for paper and can be used both for covering printed pictures and labels of all kinds. Then, too, it can be used to give a glaze to furniture. Since it is a varnish which is transparent, the original color of the woodwork will not be impaired.

As a scratch remover of varnished surfaces this particular varnish is unexcelled, but it must be remembered that only glazed or highly lustrous or finished surfaces can be freed from their blemishes; dull surfaces cannot be treated with this varnish.

When the wooden surface is light in color, this varnish need only be painted over the scratch. If it is colored, a small quantity of coloring matter should be added, although this is not absolutely necessary, as most scratches found on woodwork will disappear or at least become less noticeable with its use.

When a wax-finished article has become scratched or blemished, rewaxing the

(Continued on page 147)



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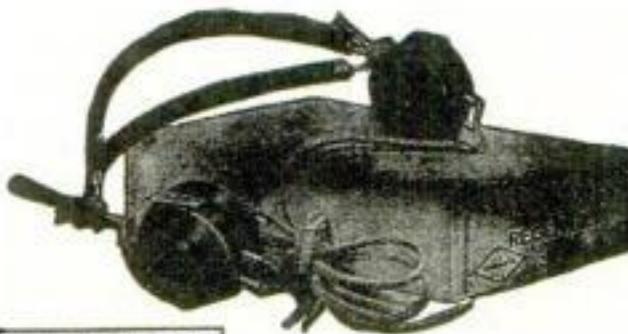
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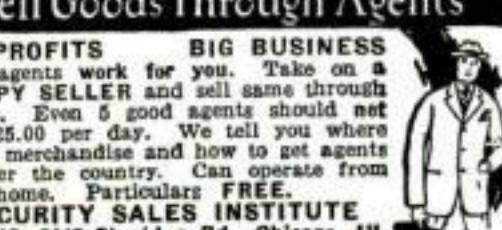
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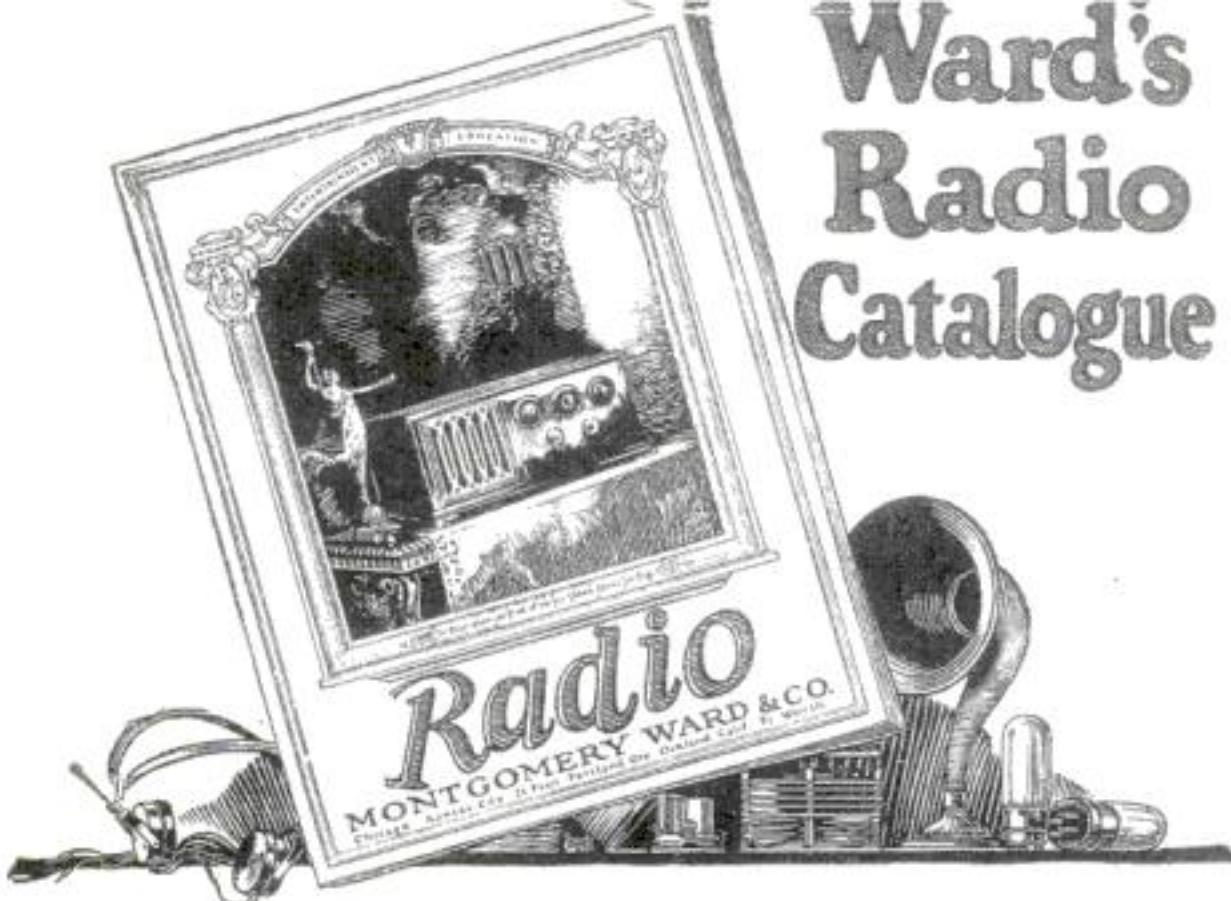
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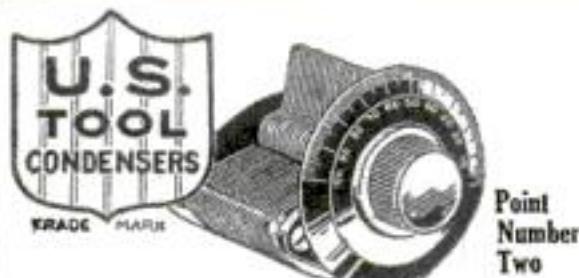
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Talcum Paint Freshens Air-Cooled Motorcycle Cylinders

IN ADDITION to the suggestions contained in the clearly written article in the July issue of POPULAR SCIENCE MONTHLY, by Austin G. Tribute, on "How to Clean and Refinish Your Motorcycle," I am sure the following treatment of air-cooled cylinders will be found valuable by motorcycle owners.

The application of paint of any kind on the radiation fins of an air-cooled motor must necessarily interfere with radiation and cause the motor to run hot. This difficulty may be overcome by mixing soapstone or talcum powder with gasoline to the thickness of cream and applying it with a paintbrush. The powder fills the pores in the cast iron and gives the cylinders a freshly finished appearance.

I apply this mixture once a week and my machine always looks well.—W. NORMAN FOX, Atlantic City, N. J.

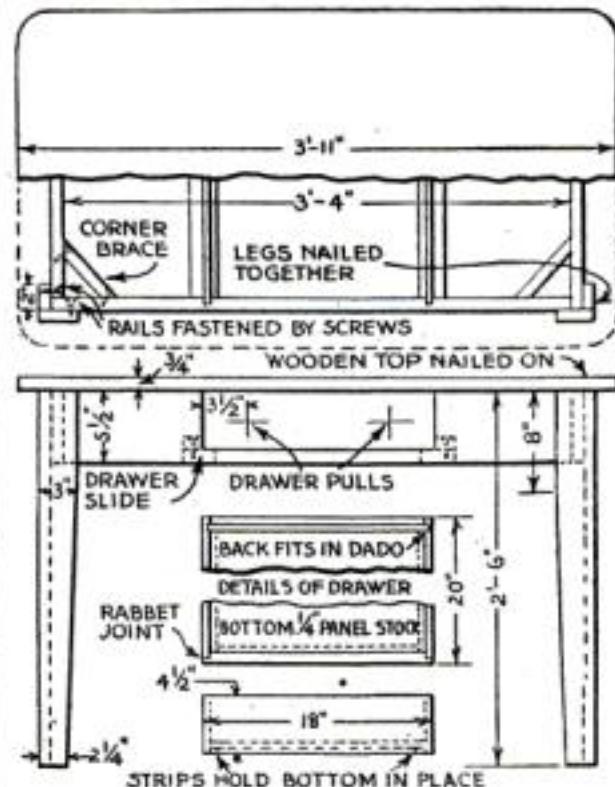
Constructing a Kitchen Work Table with Porcelain Top

By Kenneth R. LaVoy

A PORCELAIN-TOP table is not difficult to make if constructed according to the plan illustrated. Such a table gives satisfactory service and is well worth your while to build.

The top may be purchased at almost any large hardware, furniture or department store, and is the only expensive part. Obtain it before starting to work, and measure the length and width on the under side between the edges. Cut enough $\frac{3}{4}$ - or $\frac{5}{8}$ -in. boards the right length to fit inside the porcelain top. It is not necessary to glue the boards together; simply nail them to the framework when you are ready to assemble the table.

There are no difficult joints to make—the method of making the legs eliminates that. Notice that the front part of the



Front and top views of the kitchen work table and details of the drawer construction

legs are 3 in. wide at the top and taper 8 in. down from the top to $2\frac{1}{4}$ in. wide at the bottom. The sides of the legs are 2 in. at the top and taper down in the same way to $1\frac{1}{4}$ in. at the bottom.

The end rails are first fastened to the legs, screws only being used. A piece 18 in. long and $4\frac{1}{2}$ in. wide is cut from the central part of the front rail for the drawer opening.

The front and back rails should now be fastened to the legs with screws. Cut corner blocks to brace the corners.

Make each drawer slide by fastening a strip 1 in. square to a piece 1 in. thick by 2 in. wide. Both pieces should be 20 in. long. Use either nails or screws to fasten them in place. The drawer should fit snugly into the opening in the front rail and should slide in and out freely.

The sides are the same width as the front of the drawer, and are $19\frac{1}{2}$ in. long. They fit into a rabbet cut in the drawer front, and are nailed in place. The bottom, which is made of $\frac{1}{4}$ -in. three-ply stock, is held in place by being nailed to strips $\frac{1}{2}$ in. square, which are themselves nailed to the sides and front piece

(Continued on page 150)

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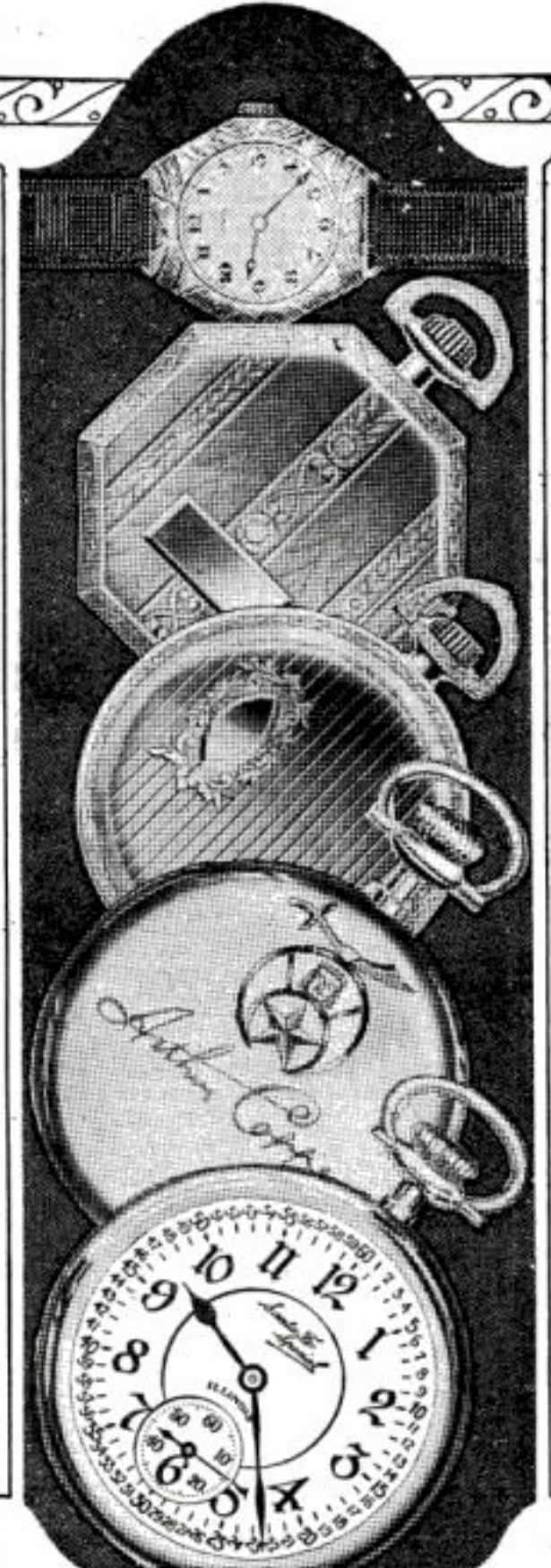
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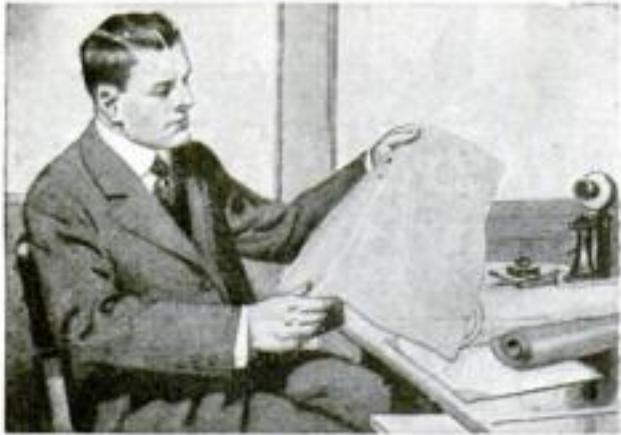
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If You Had to Leap from a Falling Plane

(Continued from page 36)

was hurled out of the plane as though from a catapult.

This plane suddenly started to drop at an altitude of 3000 feet. Attempting to check the descent, the pilot was conscious of a fluttering of the wings, a collapse of the tail surface; then found himself hurtling through the air, clear of the plane. He retained presence of mind enough to reach for the release ring and open his parachute, and so reached the ground in safety, after falling about 1300 feet. The passenger's body was found in the wreckage of the plane. The latter probably was holding himself in the plane at the time of the collapse and so prevented his safety belt from breaking and himself from being hurled out as was the pilot.

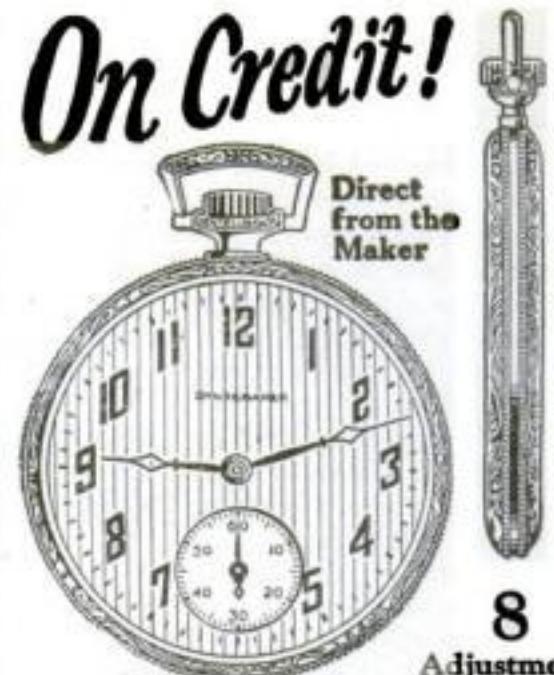
THE recent death of Dr. C. LeRoy Meisinger of the U. S. Weather Bureau, and an army balloonist, when the balloon in which they were making meteorological observations above Illinois was struck by lightning, has caused balloonists to discard the old type of parachutes used with balloons in favor of the new airplane parachutes. These men apparently tried to jump with the old type parachutes, which hung in containers at the side of the car, but the collapse of the balloon caused the car to lose its "lift" and, since its occupants could not fall faster than the car, their attempts to cause the parachutes to spread out and check their fall were futile.

Virtually all parachute jumps that have been made from airplanes have been born of necessity. Though official orders have made the parachute an essential part of the equipment of the aviator flying in the government service, though pilots have all confidence in the efficacy of the airplane parachute, and though all parachutes are tested practically by being attached to 200-pound weights and dropped from planes before they are put into service, parachute jumping is scarcely an occupation that the most venturesome would essay merely for thrill or sport.

THE greatest recorded parachute jump made from an airplane was accomplished by Capt. Albert W. Stevens a year or more ago. He fell 24,200 feet—almost five miles—landing 25 miles away from the point above which he jumped and suffering no injury in his descent, beyond a couple of dislocated toes.

Parachutes of a different kind were added recently to the equipment of the U. S. Mail fliers by the Post Office Department to safeguard fliers in making forced landings at night in strange territory. These are parachute flares—small parachutes supporting bright flares of light, much like those used in skyrockets and other fireworks, which, when released, brilliantly illuminate the ground for a mile around.

Only a few weeks ago, Frank Yager, a mail pilot, made a successful landing with the aid of flares at Wann, Neb., during a severe storm at night.



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Waiting in the Dark for the Vampire Bat

(Continued from page 39)

"Their nests are a great underground system of miniature catacombs, which can be located by the large mounds of earth that the leaf-cutters excavate. Upon arriving at home, they quickly disappear underground and stage what might aptly be termed a 'chewing match.' They chew up the greens they have brought with them, turning them into fertilizer for raising a microscopic fungous growth that grows no other place in the world except in these underground nests of the leaf-cutting ants. This fungus is their only food. The enormous quantities of green stuff they carry off are used only as fertilizer for their microscopic fungus farms!"

"IF THESE subterranean nests are attacked or dug up with a shovel, thousands of warriors who never come to the surface except in case of attack, swarm out at the intruder with their jaws wide open. These, like all the leaf-cutters, are blind and make their way by sense of touch and instinct.

"Rivaling these insects in queer characteristics is one of the most peculiar and primitive birds in existence anywhere in the world. It should have been extinct thousands of years ago, because it hasn't developed with the times. It is called the 'hoatzin bird,' and is exceedingly rare, living in a few isolated localities along river banks in dense thorny bushes called 'pimpler.'

"In appearance it is about the size of a domestic hen, beautifully colored in dark and golden brown. Its eyes are large and red and its head is topped by a small crest. It flies awkwardly, only about as well as a chicken. On the ends of its wings it carries a well developed thumb and forefinger. These it uses only when young to climb around the nest.

"For food it eats the leaves of the surrounding pimpler bushes, as well as leaves of the mucka mucka plant, which grows a single lily-like leaf on the end of a stem about 10 feet tall. The bird continues to exist only because it dwells in such inaccessible places, a remnant of the past persisting into the present, ages behind the times.

"The streams along which these birds live, in fact, any jungle stream, furnish very exciting bathing at times. The water is apt to look something like ginger ale because of the great quantities of wallava leaves on the bottom. Actually, though, the water is quite clean.

"IN THESE streams you are apt to encounter dangerous fishes called 'perai.' They are only about a foot long, but a school of them can do more damage than a shark, and can finish a man in a short time because of their many triangular teeth with which they bite and twist out a piece of flesh as neatly if it were done with an auger.

"But an even more formidable foe than these is the sting-ray, a very large circular fish somewhat resembling a devilfish. It lies along the bottom most of the time, and when any one comes near it flashes

(Continued on page 154)

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Our business, in a word, is to make pipe-smoking pleasant and enjoyable to any man that fancies this mode of tobacco incineration. We strive to do this by providing a tobacco that doesn't bite the tongue, doesn't smoke too strong, doesn't leave an after-taste.

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Please allow me to say a word of praise for "Edgeworth." Last fall I thought I would try again to smoke a pipe—so I bought a pipe and a can of "Edgeworth" and can say very gladly that so far I have not had any sore tongue nor do I feel any "after-taste" from smoking. This is more important when you take into consideration that heretofore I had been unable to smoke a pipe on account of the sickening sensation I had afterward, but that is gone forever and I am truly glad to be able to get the one good smoke. "Edgeworth."

Give my regards to
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Mr. James Edmund.
(signed) Al J. Moxley.



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To Retail Tobacco Merchants: If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size of Edgeworth Plug Slice or Ready-Rubbed for the same price you would pay the jobber.

Waiting in the Dark for the Vampire Bat

(Continued from page 153)

out a long slender tail very much like a whip, with a sharp, poisonous point. This sting is very severe, and sometimes even fatal.

"Another kind of fish demonstrates another of the wonderful ways in which Nature endows her creatures with means of protection. Sometimes when you are swimming, your whole body may suddenly become tense, as a charge of electricity runs through it, seemingly coming from nowhere. This is the original 'death ray'; it comes from an electric eel, which defends itself by hurling a miniature bolt of electricity at you. This charge will travel quite a distance through water.

"I WAS shocked twice by one of these—the second time when I was watering it after capture. As I began to pour water into the tank the eel discharged electricity into the stream I was pouring, and shocked me enough to cause me to drop the metal pan!

"But if these facts sound strange to you, what would you think if a bat flew into your bungalow at midnight, bit a hole in the end of your big toe, sucked out a good deal of blood, and then sealed the opening with saliva that nature has rendered antiseptic for just this purpose?

"This is exactly what the vampire bat does. It lives only on blood, preferably human blood, and it bites a person almost invariably on the fingers or toes, choosing the big toe whenever possible. It is about the size of our common bat, has large ears, a face somewhat like that of a little puppy, and four tiny, sharp teeth.

"IT DOES its work so stealthily that the sleeper is entirely unconscious of its presence. If the person stirs and frightens the bat away during the operation, the wound very likely will bleed until morning, but if the bat is allowed to finish undisturbed, it seals up the hole with antiseptic saliva as neatly as if it were done by a physician. The only reminder of this bloodthirsty visitor that remains the next day is a little red sore spot.

"I have lain awake at night in an effort to catch or merely feel one of these stealthy creatures at work, but they are so extraordinarily quick that they have always escaped. One night I determined to lie in readiness and catch one in the dark. As I expected, a vampire flew into the cabin shortly after midnight. I felt it light on me. Then I waited.

"The moments seemed to drag very slowly. Soon I thought I could feel the tiny sharp teeth biting into the flesh, then the running of the blood in a tiny stream. I swooped a hand forward, but it only swept the air. The bat had gone again, and when I struck a light I found that in the excitement of the moment I had not even given it an opportunity to begin its work. My sensation of feeling the flow of blood was only imagined, the result of my anxiety to experience such a sensation. So I have yet to catch a vampire bat, one of the most elusive and interesting creatures of the fascinating tropics."

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Where Electricity Gives Up Its Magic

(Continued from page 47)

from daring to travel new roads. Who knows but the research worker on almost any of these unexplored trails may transcend known possibilities? Instead of exhibiting pride at our accomplishments, we ought to register shame at our crass ignorance. Nature probably holds in store much greater things for man than he has realized or can anticipate. No one anticipated wanting laws of heredity, seeing one's bones, or using vacuum house cleaners, for example.

"We have long known that we wanted cheap power. We hate to do work that somebody else, or something else, can do for us. Now, the sun sends us about one horsepower a yard of earth surface on a good day. Some time we must devise electrical means for catching and storing it. Some substances in vacua can transform the light into electric current.

"In other words, we know *how* already, but we cannot do it well enough. Just as with the storage batteries, we know how to store electrical energy, but in the last quarter of a century there has been almost no improvement in the principles of electric storage. A combination of radical improvements in these two fields would make electricity so cheap that perhaps some of it could be applied to building improved morality!

CERTAINLY some change, not perfectly obvious at the moment, would take place. One naturally looks forward to nights as light as day, or to automobile highways, and even byways, all perfectly lighted by electric lamps; but history has shown us that our ability to prophesy is usually feeble, and frequently terribly cramped.

"There probably are in the offing many applications of electricity that we have not appreciated, but which at present costs can be made serviceable. Broadcast wireless talking movies in natural colors is an illustration.

"Power generated at the mines will be relatively more and more economical as the country becomes covered with an interlacing network of power lines. House heating by electricity should come later, and every discovery of added economy in current generation or transmission brings the day nearer.

"Wireless power transmission is only a dream at present, and we only know enough to say that we dare not say it cannot be done.

"If a thing can be imagined, then we may conclude hypothetically that somehow and some time that thing can be invented. The term 'physical impossibility' is scarcely within our category."

Referring to fused quartz—the remarkable new form of glass developed in the Thomson research laboratory of the General Electric Company—Doctor Whitney called attention to the fact that electricity, in vacuum furnaces, made this possible. Quartz glass has been found of value for reflectors and lenses of great telescopes—as well as many other uses. One remarkable characteristic is its power

(Continued on page 156)

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Where Electricity Gives Up Its Magic

(Continued from page 155)

to transmit light around turns, so that its use may be possible in getting the violet ray—which this new glass transmits—to the throat and interior of the body.

Concerning its therapeutic value, however, Doctor Whitney is extremely conservative. He says:

"Outside of the General Electric Company, experiments have been made to determine the effect of ultra-violet light through fused quartz upon chickens reared in a dark or gloomy place. It has been stated that before the treatment was administered, the bones of the chickens were incompletely calcified—something analogous to rickets in children; and that after treatment the bones grew normally.

"As with the X-ray, the laboratory should investigate these statements. While not discounting the work of other scientists, it must know all the conditions under which the experiments were made. For instance, it wants to know that the feeding of the chickens, or accidental varieties, had nothing to do with the change in the bones. In short, before we accept claims for the curative powers of the violet ray, we must know that such experiments are conclusive."

IN RESEARCH work the X-ray is an important tool. Through the X-ray spectroscope scientists study the nature of atomic combinations. They look into the interior of matter and see the actual atomic arrangement. On this work may hinge the solution of practical problems, including such questions as the conductivity of copper, the magnetic permeability of iron, and other enigmas. X-ray tubes developed during the last year have 15 times the energy of the average tube.

Referring to other phases of the X-ray, Doctor Whitney went on:

"Doctor Coolidge expanded its application in different directions, and, as Mr. Hawkins, engineer of the laboratory, points out, it is entirely possible that vacuum tubes will be used in the super-power transmission of the future.

"Now just for a moment consider the wonder of the vacuum, whether it be in an X-ray tube or a lamp. Mr. Hawkins shows that the vacuum in a well-exhausted lamp is considered a high vacuum. Only one molecule out of 100,000 in the original atmosphere is left. But now to get such a vacuum as we have in the modern power tube, we must take that exhausted lamp and pump it, until of that residual gas we again have left only one molecule out of 100,000. Thus we bring the pressure down to one ten-billionth of an atmosphere!

"And here comes in perhaps the biggest marvel of all. In spite of our high vacuum we still have remaining about forty billion molecules to the cubic inch. You can get a faint conception of the smallness of the molecule when you realize that if we enlarged the forty billion molecules in one cubic inch to the size of grains of sand, they would make a beach 3000 miles long!"

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Are Men Smarter than Women?

(Continued from page 50)

gressive, on the whole, than some men.

Women are more interested in personalities; men in things and facts. Last summer a young woman relative of mine attended a course of lectures at one of the large Eastern universities. Some of the most noted scientists of the United States and Europe were among the speakers. At the close of the course I asked the girl how she had enjoyed it.

"Oh," she said, "there was only one good speaker among all those men. He was a young man—and perfectly lovely!"

WHY wonder why the newspapers chronicled the doings of the Prince of Wales at such length!

When Mrs. Smith goes to the theater, she is likely to lose sight of the art of the best actor in the world—if he plays the villain. But she will be "thrilled" by an indifferent performer who is handsome and plays the hero.

Men are interested in what people have done. The legislative record of a Presidential candidate while he was governor of a state or a United States Senator means more to a male voter than whether he loves his family or attends church regularly.

Bill Smith, though, must give way to his wife when it comes to knowledge of human nature. Woman's care of children gives her an insight into human nature raw, before it becomes coated over with its varnish of cultural inhibitions, evasions, and camouflage. In fact, Mrs. Smith's instinctive, ingrained knowledge of the peculiarities of humankind is likely to cause her to understand Bill a great deal better than Bill understands himself.

THE belief, though, shared by Bill Smith with all other men, that he is not only wiser than his own wife but than all other women, probably will always endure, no matter what evidence psychology may produce that this opinion is entirely unfounded.

The reason is not difficult to find. Women tend to be submissive, men assertive. And when Mrs. Smith gives in "to keep peace in the family," Bill quite naively concludes that he's the brighter.

Also, men earn the money as our social order is constructed, and so hold the balance of power. It appears to be a human weakness that as soon as a person becomes powerful he feels all-wise.

Men as a species are more variable than women. The geniuses and the most hopelessly stupid usually are men. Psychology shows that probably one man in a hundred is brighter than almost any woman. The Caesars, Napoleons, Lloyd Georges and Edisons probably always will be men—but likewise the biggest fools probably will be men as well. This is not much satisfaction to the average man, who would like to bask in the reflected glory of the great, but it is the evidence that science gives.

Men and women are equals and complements. They will have to pursue, evade, love, hate, and live it out on this basis till the end of time.

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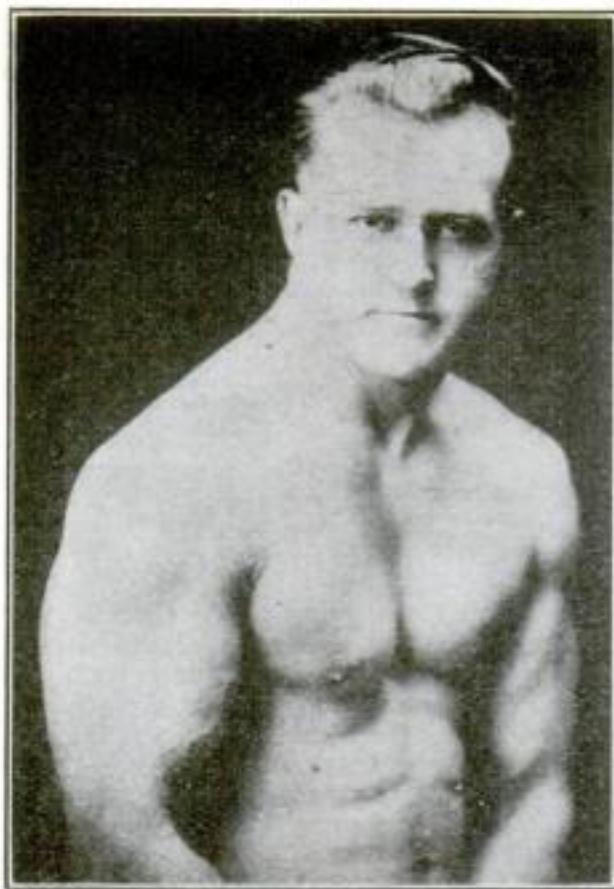


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A Re-Built Man

I like to get the weak ones. I delight in getting hold of a man who has been turned down as hopeless by others. It's easy enough to finish a task that's more than half done. But give me the weak, sickly chap and watch him grow stronger. That's what I like. It's fun to me because I know I can do it and I like to give the other fellow the laugh. I don't just give you a veneer of muscle that looks good to others. I work on you both inside and out. I not only put big, massive arms and legs on you, but I build up those inner muscles that surround your vital organs. The kind that give you real pep and energy and the courage to tackle anything set before you.

All I Ask Is Ninety Days

Who says it takes years to get in shape? Show me the man who makes any such claims and I'll make him eat his words. I'll put one full inch on your arm in just 30 days. Yes, and two full inches on your chest in the same length of time. Meanwhile, I'm putting life and pep into your old back-bone. And from then on, just watch 'em grow. At the end of thirty days you won't know yourself. Your whole body will take on an entirely different appearance. Now comes the real work. I've only built my foundation. I want just 60 days more (90 in all) and you'll make those friends of yours who think they're strong look like something the cat dragged in.

A Real Man

When I'm through with you, you're a real man. You will be able to do things that you had thought impossible. And the beauty of it is you keep on going. Your deep full chest breathes in rich pure air, stimulating your blood and making you just bubble over with vim and vitality. Your huge, square shoulders and your massive muscular arms have that craving for the exercise of a regular he man. You have the flash to your eye and the pep to your step that will make you admired and sought after in both the business and social world.

This is no idle prattle, fellows. If you doubt me, make me prove it. Go ahead. I like it. I have already done this for thousands of others and my records are unchallenged. What I have done for them I will do for you. Come then, for time flies and every day counts. Let this very day be the beginning of new life to you.

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Who Says the Weather Man Is Always Wrong?

(Continued from page 53)

sale. Street-railway companies arrange for more heat for their cars. Natural and artificial gas companies turn on more gas. Coal dealers supply partial orders to all customers needing fuel, instead of full orders to a few. Iron ore piled up for shipment is placed in the holds of vessels to prevent the great masses from freezing solid. In a single instance, Marvin told me, a cold-wave warning saved more than \$3,500,000 through the protection of property from injury or destruction.

Warnings of frosts and freezing weather also prevent heavy losses to growers of fruit, sugar, tobacco, and garden truck. In Florida and the South Atlantic and Gulf states fruit-growers and truck gardeners are largely dependent for success on the service of the Weather Bureau. On the farm, potato digging is suspended when a cold wave is foretold, and the dug potatoes are removed from the field. Beans, grapes, and other crops are saved by picking in advance of a freeze. Marvin considers this service one of his most important responsibilities.

RIVER and flood service conducted by the bureau makes possible the issue of flood warnings, with life-saving significance. Aviation is almost entirely regulated by weather forecasts.

In their own way, the weather statistics kept by Marvin and his department are as important as weather forecasts. They are called upon to settle many problems. Insurance companies now insure against rain, drought, crop failure, hail, tornadoes, hurricane and other destructive phenomena. The policies cover various enterprises from crops to fashion shows, entertainments, and baseball games. For the basis of rate computation and the settlement of claims, Marvin's Weather Bureau data serve as a court of last resort.

"But how are old records of any possible use to any one?" I asked Marvin.

"Let me illustrate," he replied. "A recent suit involved a collision between a motorcycle and a work team. The cyclist was badly injured. When he sought to collect damages, the teamster stated that the road was smooth and that the motorcycle might easily have turned aside. Armed with weather records, the cyclist showed that the road was deeply rutted from recent rains; and since he was in the right-hand path it was decided he had a legal right to expect the teamster to yield."

IN CRIMINAL cases, too, the weather records sometimes spell the difference between conviction and acquittal.

Take a murder case that stirred a Western community some time ago. A bank messenger had been held up and shot in broad daylight. Within less than an hour a man was arrested on suspicion. Strong evidence linking him with the crime was met by a convincing alibi.

Cross examination failed to shake his story until the prosecutor asked him about the weather on the day in question.

(Continued on page 159)

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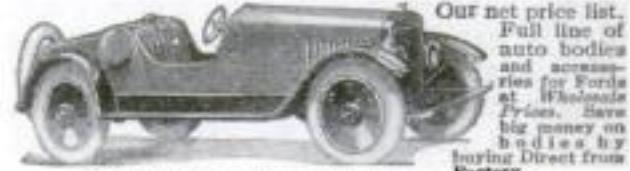
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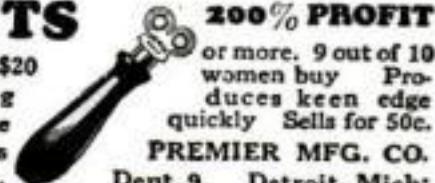
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Who Says the Weather Man Is Always Wrong?

(Continued from page 158)

He swore the day was bright and sunny.

The prosecutor then produced the records of the local weather office for that day. The graphic chart showed that there had been a heavy rainfall in the banking district within a few minutes of the tragedy. Testimony of the detective and other police officials established the fact that at the time of the arrest the prisoner's clothing bore evidence of exposure to recent rain. These revelations broke the alibi, and brought conviction.

IN ANOTHER case the weather chart saved an innocent man. The chief witness against a prisoner accused of burglary was a city policeman who claimed to have seen the accused as he fled from a wholesale grocery store that had been entered and robbed. The officer testified that he had opportunity to make an accurate mental photograph of the fleeing man's figure and characteristics, although unable to capture him at the time. Things looked gloomy for the prisoner until his counsel questioned the policeman concerning the distance that separated him from the escaping burglar. The witness placed the distance at 200 feet.

At this stage the suspect's lawyer introduced the weather records of the night in question. The chart and official testimony showed that a dense fog covered the city at the time the burglary was committed. Interrogation made it obvious that the fog was so thick that 200-foot vision was impossible. On the strength of this showing the jury gave a verdict of acquittal.

MARVIN told me that weather records are valuable for the person contemplating a change in the location of his home. An ambitious colonization scheme, undertaken in good faith, was abandoned because the records showed the summers in the locality were too short and the nights too cool for such crops as barley and flax, and entirely prohibitive for other crops.

Weather records play a vital rôle in city planning. By determining the prevailing wind directions, the planners are able to locate industrial districts so that factory smoke will be blown over residence districts as infrequently as possible. Practical use of the records for this purpose was recently seen in Springfield, Ill., where the plans included a factory district and a new union station for a steam railroad.

Marvin believes that meteorological science has by no means reached its limits in forecasting.

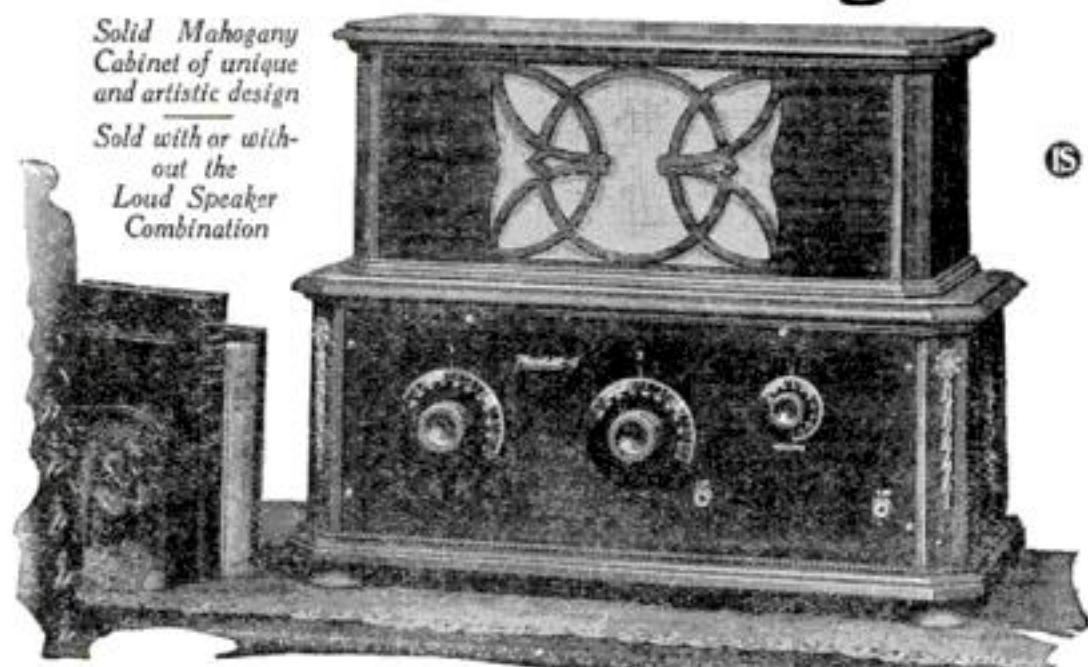
"No scientist," he told me, "can demonstrate, I believe, that weather predictions of a general character for a considerable period of time in advance are inherently impossible."

"We must always remember that the thing that is not impossible must be possible. This, then, should be the justification of those who seek to advance the science and art of meteorology in the difficult field of long-distance forecasts."

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What Set Shall I Buy?

(Continued from page 56)

receiver is constructed on the so-called *neutrodyne* principle. The neutrodyne is normally a five-tube receiver. In the case of the four-tube neutrodyne, one tube is eliminated by reflexing.

Among five-tube sets the neutrodyne has been especially popular since its introduction. I would call it the best all-around receiver for the average man. It is simple in operation; it generates no squeals to annoy neighboring listeners; it will give loudspeaker operation from 500 to 1000 miles or more; its control dials may be charted so that once their positions are found for a particular station, the station may be tuned in at any future time by resetting the dials to those positions. Receivers of this type cost from about \$100 to \$175. They will give satisfactory reception almost anywhere on an indoor aerial. Other five-tube sets, recently introduced, possess advantages similar to those of the neutrodyne.

IN GENERAL, six-tube and other multiple-tube sets are designed on the principle that the increase in energy, due to amplification, will compensate for the difference between the strength of signals received on an outdoor or indoor aerial. Thus, a six-tube set, using a loop aerial, will give a man living in a city apartment house approximately the same results he might obtain elsewhere with a three- or four-tube set using an outdoor antenna.

This is one reason why sets of the *super-heterodyne* or modified super-heterodyne type are particularly suited to city dwellers or others who cannot use outdoor aerials, though sets of this type, while expensive, are suitable for every locality, since they are the most sensitive and selective sets made. These sets employ six to nine tubes, but, due to utilization of the reflex principle in their construction, all possess about the same efficiency. They may be assembled from parts costing from about \$80 to \$120, or may be purchased complete from approximately \$200 to \$450.

MOST sets today are sold without accessories such as tubes, batteries, phones, aerials, and so on. The purchase of these essential parts will form no small part of your total expenditure for radio equipment. For a long time the price of vacuum tubes has been stable at five dollars each, although a large manufacturer recently reduced the price of tubes to four dollars. A storage battery will cost you between \$10 and \$20. Your B battery, which is necessary whether you operate your set by storage batteries or dry cells, will cost from two dollars to about eight dollars, depending upon how many units are required to operate your set. Dry cells, if used in place of a storage battery, cost from 30 cents to 50 cents each. You can buy head phones for from \$3.50 to \$12 a pair, and loudspeakers range in price from \$10 to \$55. Your aerial and ground connections, including lightning arrester and insulators, will cost between \$3.50 and \$7.50. For a battery charger, if you use a storage battery, you must pay from about \$12 to \$20.

(Continued on page 161)



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IV

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What Set Shall I Buy?

(Continued from page 160)

A storage battery is more expensive at the outset, but it is probably cheaper in the long run, because dry cells must be replaced frequently. A storage battery is more efficient electrically than dry cells; that is to say, it will deliver current almost to its full capacity right up to the moment of complete discharge, while dry cells become gradually weaker, and adjustments of the set must be made in compensation. Storage-battery tubes give better results than dry-cell tubes, but the two types of tubes are not interchangeable.

If you start off with dry cells, you must continue, or buy an entire new set of tubes if you change batteries. A storage battery, however, must be charged frequently, and, unless your home is wired for electricity so that you can do this yourself, you will have to pay for recharging and also suffer the inconvenience of having your battery removed at intervals for this purpose.

THE principal factors, I should say, that have bearing on your choice of a radio set are, in order: The price you wish to pay, the location of your home, and the use you wish to make of the set. Before making your purchase, then, I should suggest that you place the following information before your local dealer, or some other radio expert who is familiar with your local conditions:

1. Your price limit.
2. The type of building in which you live, the type of surrounding buildings, the floor you occupy.
3. The distance from which you hope to receive, whether you will use indoor or outdoor aerial, whether you will use loudspeaker or head phones, whether you want entertainment or just "distance."
4. Whether you wish a portable or stationary set; whether you will use a storage battery or dry cells, whether you wish an ornamental set.

With this data, any one who knows local conditions and is familiar with the capabilities of the common types of radio sets ought to be able to aid you in selecting the radio receiver that best will fit your particular requirements.

FOLLOWING Mr. Senauke's plain directions, you can easily select the type of radio set that will fit your requirements. To make certain, though, that you are obtaining an honestly made, dependable set, before you buy, write to the Popular Science Institute of Standards for list of radio manufacturers whose products have been tested and approved.

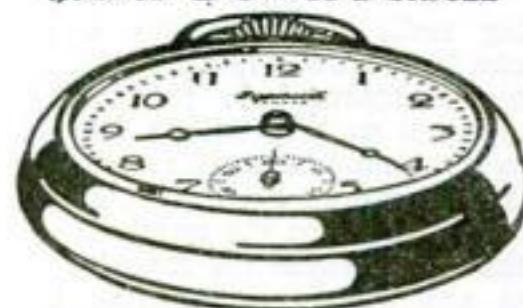
Recent Publications

Dunlap's Radio Manual, by Crrin E. Dunlap, Jr. An excellent popular presentation of many phases of radio. Illustrated. Houghton Mifflin Company.

Relativity and Gravitation, by T. Percy Nunn., M. A., D. Sc., professor of education in the University of London. The Einstein theory discussed for students of mathematics. E. P. Dutton & Company.

Outlines of General Zoology, by Horatio Hackett Newman, professor of zoology in the University of Chicago. Illustrated. The Macmillan Company.

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How Your Radio Set Works

(Continued from page 60)

vase caused its natural rate of vibration to be lowered to correspond with the frequency of some lower note. In other words, each note of the piano sends its vibrations to the vase, each set of vibrations tries to make the vase vibrate in sympathy, but all are unsuccessful except the one set to whose frequency the vase is tuned.

SO WITH your radio receiver. Radio waves that have energy enough to reach it try to persuade it to take up their vibrations. These are a very different kind of vibrations from those of a piano wire; they are electric vibrations; so, in order to shut out those you don't want and let in those you do, you add to your receiver or take away from it certain electric properties, just as you might add water to a vase or take it out to make it vibrate when particular notes are struck on the piano.

The electrical properties which you vary in your receiver to tune it to one particular set of radio waves are known as "inductance" and "capacity." The first is obtained by means of various types of wire coils, the second by means of condensers. A technical understanding of the way these devices work is not necessary to an appreciation of the fundamental principles of radio. Think of them as serving the same purpose as the water placed in the vase in the case of the piano. You change the amount of water in a vase to tune it to certain musical notes; you change inductance and capacity in a radio receiver to tune it to radio waves of certain rates of vibration.

However, it is not often that you hear of the rate of vibration of the radio waves sent out by a particular station. The term you do hear is the *wave length*.

All radio waves move at the same speed—186,000 miles, or 300,000,000 meters, a second. If this number is divided by the *frequency* of the waves, the wave length—the distance from crest to crest—is the result.

NOW, after the inductance and capacity of the receiver are adjusted to admit only waves of 400 meters, say, and to exclude all others, these waves still remain alternating-current waves of radio-frequency. Their electrical energy must be prevented from reversing itself at rapid intervals, their rate of vibration must be lowered if they are to be heard in your telephones. So, from your tuner, you lead the radio waves—or the infinitesimal portions of them that your set has absorbed—into a *detector*.

Admitting the rapidly vibrating, alternating radio currents into a *crystal detector* is something like forcing a fancy skater, accustomed to performing his complicated evolutions in a large rink, to do his tricks in a small room. Just as the skater cannot swing so widely, nor twist so rapidly in the restricted space, so the radio waves are forced to slow down and stop their twisting to get through the crystal.

What actually happens is that the electrons that compose the crystal offer

(Continued on page 163)

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How Your Radio Set Works

(Continued from page 162)

opposition to the alternate push and pull with which the radio currents try to set them in motion. At some points of the crystal greater opposition will be offered to "push" than to "pull," and vice versa. It is quite like further restricting the movements of our fancy skater by placing objects on the floor of the small room around which he must skate.

The proper thing, then, is to introduce the radio currents to the crystal at a point where "push" is so much greater than "pull" or "pull" than "push" that the flow of current through will be virtually in one direction. A point where this will take place is what users of crystal sets call a "hot spot." These currents then can be led to the headphones. They will cause the diaphragms to vibrate in accordance with the interruptions of the carrier wave caused by speech or music in the studio—and you will hear the broadcasting.

Using a vacuum tube as a detector differs from the use of a crystal in one important particular. Whereas the original energy of the radio waves passes directly from the crystal to the headphones, a vacuum tube uses this energy, not to operate the headphones, but to actuate a more powerful source of energy, which in turn operates the phones. There, in a word, is the explanation of why a vacuum tube receives broadcasting from longer distances and gives louder signals than a crystal detector.

JUST as in the transmitting tubes described in the first article of this series, in a tube used for reception a flow of electrons (negative charges of electricity) is produced from *filament* to *plate* by heating the former and making the latter positive by means of electric current. Two batteries are employed for this purpose, called "A" and "B" battery respectively.

The radio currents are permitted to pass from the tuner across the electronic "bridge" in the tube, and their passage is regulated by the *grid*, a network of wires placed between filament and plate, which opposes or aids the flow of electrons, as it becomes alternately positive and negative. This action of the grid is controlled by the received radio currents; hence, variations in these currents cause corresponding variations in the (direct) current of the "B" battery, causing the telephones to repeat the sounds made in the broadcasting station.

The operation of the telephone or loud-speaker—for a loudspeaker, of course, is only a magnified telephone—every one probably understands. You hear their sounds because electromagnets, controlled by electric currents that vary in accordance with the vibrations of the sounds being broadcast, cause the diaphragm to move back and forth in imitation of those sounds.

There can be—and usually is—much auxiliary apparatus in a radio set in addition to what I have described here. I have not attempted to outline any radio "circuit." What I have tried to do is describe the essential parts of a radio receiver in the simplest possible way.



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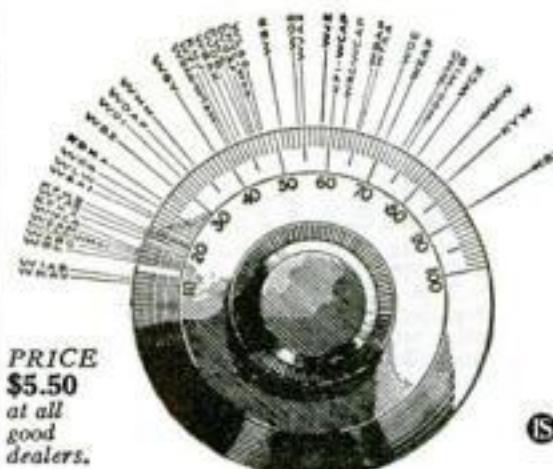
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Are You Growing Deaf?

(Continued from page 84)

First he should test this ear with the watch. Then he should go into a quiet room and have some one whisper to him, starting at 20 feet away, and then gradually approaching. He should hear the whisper at least 19 feet away. If he cannot hear an ordinary whisper at a fairly distant point, he should be tested by the ordinary voice in the same way. The voice, speaking numbers instead of words, should be heard at least 20 feet away.

IF ANY of these tests indicate defective hearing, he should go to the nearest ear specialist, who will test his ears by more accurate methods, with tuning forks, and other instruments. Perhaps something can be done to remedy the defect in the "good ear." But sure as fate if he continues to neglect this ear such a person will become hopelessly deaf.

Within the past few years, science has perfected an instrument called the "audiometer," which provides very accurate tests of hearing. The instrument recently has been adopted for tests by the United States Army. A record with the audiometer will show the exact percentage of hearing a person has lost, and whether this loss is in the upper or lower tones.

Such knowledge is of great importance. If a person is deaf to the lower tones, it usually indicates some trouble with the middle ear which can be corrected. If he is deaf to the higher tones, it usually means some defect in sound perception—a condition caused by trouble in the internal ear or the nerve of hearing.

THE statement has been made that most hearing defects of adults originated in childhood. But remember that it is possible to become deaf as the result of disease, the constant use of certain drugs, or because of certain occupations. For example, drugs, such as quinine and some of the coal tars, may affect the auditory nerve. Again, influenza may cause deafness, either because of its local effect, or because of poisons freed into the system.

Among occupations which cause deafness are work in chemical plants where there are constant fumes, such as chlorine or phosphorous, or employment where there is continual pounding on the ear drum—riveting and boiler-making.

Many men were made deaf during the war by the constant thunder of big guns, which hammered on the ears until the drums actually became loosened and could no longer transmit sound.

It is unfortunate that the scientist cannot take out an ear and examine it minutely in the same way that he can an eye. If he could do that, we might know more about curing hearing defects.

The question of how well you hear may not assume importance to you unless some one dear to you is deaf, or unless you have lost your hearing to some extent. It is an old saying that the only way to cure deafness is to prevent it. Unfortunately, in the majority of cases, preventive treatment is started too late. But it is a gratifying fact that people everywhere are learning the value of caring for their ears.

Here Are Correct Answers to Questions on Page 79

- The liquid part of the blood contains an ounce or so of salt. So do all the secretions from the body, like tears and perspiration. Salt is being lost continually from the body in these secretions and enough salt to make up this loss must be supplied regularly with the food.
- Because that is the way mountain ranges are formed. As the earth shrinks, it wrinkles up its surface skin a little. These wrinkles are what we call mountains.
- Fundamentally it is, for both electricity and matter are made up of electrons. But in the atoms of matter the electrons have a permanent place in the atom and each atom contains, besides electrons, a nucleus. Electricity, on the other hand, consists of loose electrons attached neither to atoms nor to nuclei.
- The great blocks of stone were hauled up on inclined embankments built of earth, the motive power being gangs of men hauling on ropes.
- No. Water boils always at the same temperature of 212 degrees, so long as the pressure of the air does not change. Water may boil faster, but will not get any hotter.
- By means of the spectroscope, which is an instrument for analyzing their light and determining what chemical elements are in the glowing substance from which the light comes.
- The fire requires two things—the oxygen of the air and something to combine with it, like coal. Oxygen makes coal burn or coal makes oxygen burn. Neither can burn alone.
- Entirely by shortening their length. Muscles always pull, they never push. Your arm moves upward because a muscle on the upper side pulls it up. When your arm moves downward it is because this first muscle is relaxed and another muscle on the under side of your arm contracts.
- The idea that there are two kinds of electricity is not held any more. It is a part of the older theories that were believed before electrons were discovered. We now believe that all electricity is made up of electrons. Electrons are negative. What the older theories called a negative charge we now recognize as an accumulation of excess electrons. A positive charge is merely a place where there are too few electrons.
- Not according to any ordinary definition of life. Living matter is characterized by certain things that it can do, such as breathe and move and eat food and reproduce itself. A stone has none of these characteristics.
- They are carried by some kind of electric impulse that runs along the nerve, but this is not a mere electric current like that in the wire of a telegraph. It is something much more complicated than a current. It seems to involve chemical changes as well as electrical ones, as though a whole series of little electric batteries were strung along together one after another inside the nerve. Exactly what happens is unknown.
- This is undoubtedly a tendency of the unconscious mind preserved from savage times, when the wearing of gold buttons or amulets or nose rings was both a necessary precaution for protecting one's wealth and a visible sign of consequence and authority in the tribe.



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Entering the field late last year, the Balkite Battery Charger is today universally accepted as one of the most efficient and trouble-free methods of charging radio batteries.

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3. It has no moving parts or bulbs.
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7. It delivers a taper charge, and cannot damage the battery by overcharging.
8. It cannot fail to operate when connected to the battery and line current.
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10. It is simple, efficient and indestructible except through abuse.
11. Without added attachments the charger may also be used to charge "B" storage batteries.
12. It can be used while the set is in operation without disturbing sounds.

The Fansteel Balkite Battery Charger will charge the ordinary 6 volt radio or automobile storage battery at 3 amperes, from 110-120 AC, 50-60 cycle current.

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Fansteel Products Company, Inc.
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Price \$19.50



*West of Rockies \$20
In Canada \$27.50*

At your dealer's. If your dealer cannot supply you, send prepaid on receipt of price

FANSTEEL
Balkite
Battery Charger

To Build a Short-Wave Receiving Set

(Continued from page 62)

last one perfectly straight. Then, at the point where the coil is to start, slip a strip of gummed paper under the wire. One quarter way around the bottle put on another strip; a third, halfway around; and the fourth, three-fourths way around. This will give you one complete turn on the coil.

Moisten the gum on the strips and wind on one more turn, making a total of two. Opposite where the winding started, bring the wire off to the side and put a single turn around the bottle. Lift the ends of the strips so that they will not be under this extra outside turn. Having completed the extra turn, bring the wire back to where it started and put on 10 turns. At the end of the tenth turn, bring the wire off to the side again and put a turn around the bottle, keeping it free from interfering with the ends of the strips. Again, bring it back and put on three turns. This completes the winding.

NOW come the finishing touches. Cut off one end of the first strip just a little bit shorter than the coil is wide, and, after wetting the gum again, bend the end over and stick it on the wire. Do the same thing with the other end of the strip. That will hold the wire temporarily. Cut off the extra wire at the start and finish of the coil, leaving leads about 6 inches long. Also cut each extra turn at a point diametrically opposite the place at which the extra turns were started. That will make four more leads which, with the start and finish, make six leads, two for each of the three coils. Now cut off the other strips, bend them over, and stick them down.

This done, hammer the glass bottle gently until you have broken it out from within the coil. You will then have a finished self-supporting winding. The fifth strip mentioned is to be wound around the coil over the first strip where the leads come off. This is to provide a little additional strength at this particular point.

When you are ready to assemble the other instruments, put the condensers, telephone jack, and panel support pillars on the front panel. The panel support pillars should be $3\frac{1}{4}$ inches long, $\frac{3}{8}$ inch in diameter, and threaded at each end for 6/32 screws. These are standard items at most radio stores. Then mount the sub-panel on the pillars.

THE tube panel should not be put in place until it has been completely wired. In the rear view (Fig. 1) you will see a short brass pillar on the left hand rear terminal screw, in place of the usual thumb-nut. Another similar pillar is used on the terminal screw diametrically opposite. These pillars, $\frac{3}{4}$ inch long by $\frac{5}{16}$ inch diameter, threaded for 6/32 screws, are employed to fasten the socket to the under side of the tube panel. Connections are made with these points by soldering lugs between the threaded washer on the socket and the pillar.

To make the appearance a little simpler, the supports for the automatic current regulators, used in place of rheostats, are fastened right on the tube panel. One

regulator is of a type for small-size dry battery tubes, while the other is for standard tubes. By pulling out or pushing in the little anti-capacity switch on the tube panel, either one can be put into the circuit. This is easier, perhaps, than using a rheostat.

The exact wiring is shown in the circuit diagram (Fig. 7). As much wiring as is possible should be done before the coil unit is put on the panel.

WHEN you are ready to mount the coil, hold it under the tube panel so that the two-turn coil, which is in the primary or antenna circuit, is next to the panel. Cut off the leads from the antenna coil so that they will run directly to the antenna and ground binding posts. Solder them in place. This gives a temporary mounting for the coil. Then run the secondary lead next to the antenna coil to the grid leak and grid condenser, and the other secondary lead to the A-battery binding post. After that, connect the end of the tickler coil next to the secondary with the fixed plates of the regeneration condenser, and the bottom end of the tickler coil with the plate binding post on the socket.

The exact order of these leads is important, for the set will not regenerate unless the directions are followed out precisely. It is essential also to connect the upper, or grid, end of the secondary with the fixed plates of the wave-length condenser, to avoid body-capacity effects. The balance of the wiring is shown clearly in the diagram.

When the set is completed, a six-volt battery should be placed across the A-battery binding posts, and a 22- to 45-volt battery across the B-battery binding post. The antenna and ground are put on the other two terminals. So as to make no mistake, if you use a small dry battery tube, take out the automatic current regulator marked A, and see which setting of the switch cuts in the control for the tube. After that you can leave both regulators in place and throw the switch to whichever one goes to the tube you are using.

SET the regeneration condenser at about maximum capacity and vary the wave-length condenser back and forth until signals are heard. Then reduce the capacity of the regeneration condenser until the set stops oscillating. If it does not oscillate, as is indicated by a double plucking sound when the grid terminal of the socket is touched, reverse the leads from the lower or tickler section of the coil. You may have to put a fixed condenser of .00025-microfarad capacity across the terminals of the regeneration condenser, although that should not be necessary.

The wave length of this outfit runs from approximately 50 to 125 meters, sufficient range to cover practically all the important short-wave transmitters.

ANOTHER useful radio construction article, will appear in next month's issue.

This One



FFFFS-HS4-K9D6



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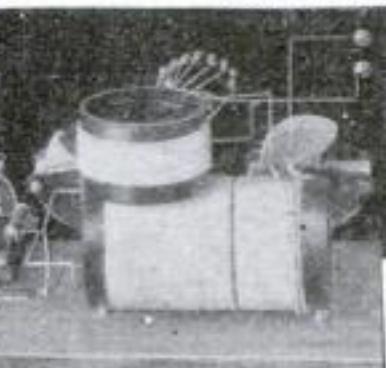
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2 Bakelite Rheostats.
2 Bakelite Sockets.
2 2-circuit Jacks.
1 1-circuit Jack.
1 Baseboard.
9 Binding Posts.
Diagram and Instructions
for wiring.

\$10.90

COMPLETE PARTS FOR 3 AND 5-TUBE NEUTRODYNE RECEIVING SET
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1 7x28x $\frac{1}{2}$ Drilled Panel. **PARTS FOR 5-TUBE SET:** 3-Gang Bakelite Socket.
2 All American or Columbia Audio Transformers. 35 feet Hook-up Wire.
3 4" Bakelite Dials. 8 Binding Posts. 1 Wave Control Neuroformer.
3 Filament Control Jacks. 1 Grid Leak and Condenser. 2 R. F. Neuroformers.
1 Vernier Rheostat—30-ohm. 2 Bakelite Sockets. 1 Baseboard. **5-TUBE SET**
1 Plain Rheostat—6-ohm. 1 .001 Condenser. 2 Neutrodous
1 strip Bakelite, 6x1 $\frac{1}{2}$. 1 Dubilier By-Pass Condenser. 3 Bezels.
Complete blue-prints and working diagrams and instructions.

PRICE—3-Tube Set, \$26.45

\$43.75



COMPLETE PARTS FOR 3-TUBE COCKADAY RECEIVING SET

1 Cockaday Coil. 2 Double Circuit Jacks.
2 23-plate Hy-Grade Cond. 2 3" Bakelite Dials.
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1 Bakelite Rheostat, 6-ohm. 7 Switch Points, 2 stops.
3 Bakelite Sockets. 1 Bakelite Binding Post Strip.
1 high ratio Columbian or All-American Transformer. 8 Binding Posts.
1 Single Circuit Jack. 1 7x21x $\frac{1}{2}$ Drilled Bakelite Panel. **3-TUBE SET**
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Complete blue-prints and wiring diagrams.
1-Tube Set. \$19.95

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ACME 4-TUBE REFLEX

3 Acme A-2 Transformers
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4 Bakelite Tube Sockets
1 Duplex or Bremer-Tully Lo-loss 23-plate Condenser.
1 Frost Potentiometer-Rheostat.
1 .00025 Fixed Condenser with grid leak mounting.
1 .0025 Fixed Condenser.
2 .002 Fixed Condensers.
1 .005 Fixed Condenser.
1 RW Crystal Detector.
8 Binding Posts.
1 3" Bakelite Dial.
1 2-circuit Phone Jack.
1 length Spaghetti.
25' No. 14 Hook-up Wire.
1 50,000-ohm Grid Leak.
1 "C" Battery.
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Complete set blue-prints and instructions for wiring.
4-Tube Set

\$39.85

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2 30-ohm Bakelite Rheostats. 1 Single Circuit Jack.
1 .00025 Fixed Condenser. 2 2-Circuit Jacks.
4 .002 Condensers. 8 x 35 Baseboard.
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Instructions, blue-prints and complete layout.

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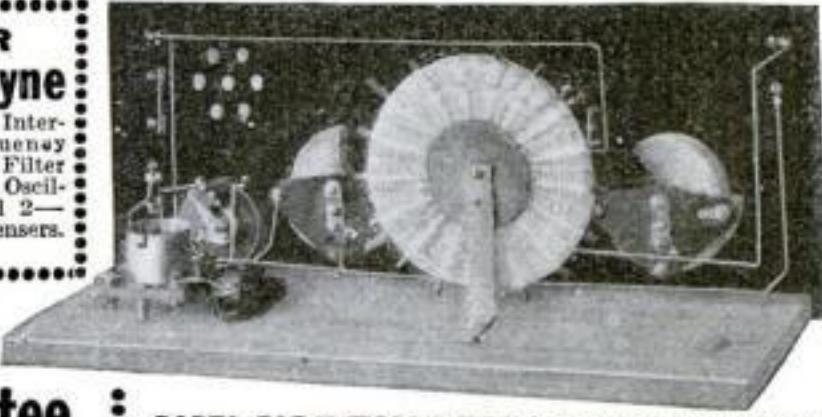


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2 Bakelite Dials. 1 Freshman Grid Leak and Condenser.
3-Tube Set. 1 Baseboard. 1-TUBE SET
9 Binding Posts. \$17.55

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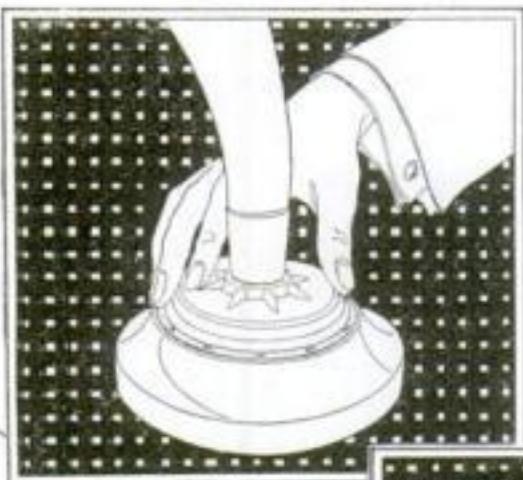
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ATLAS floods the room with the best that's in your set. Write for the interesting booklet you ought to read before buying any speaker.

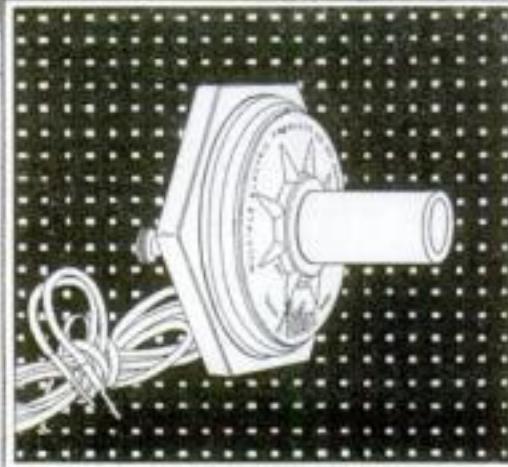
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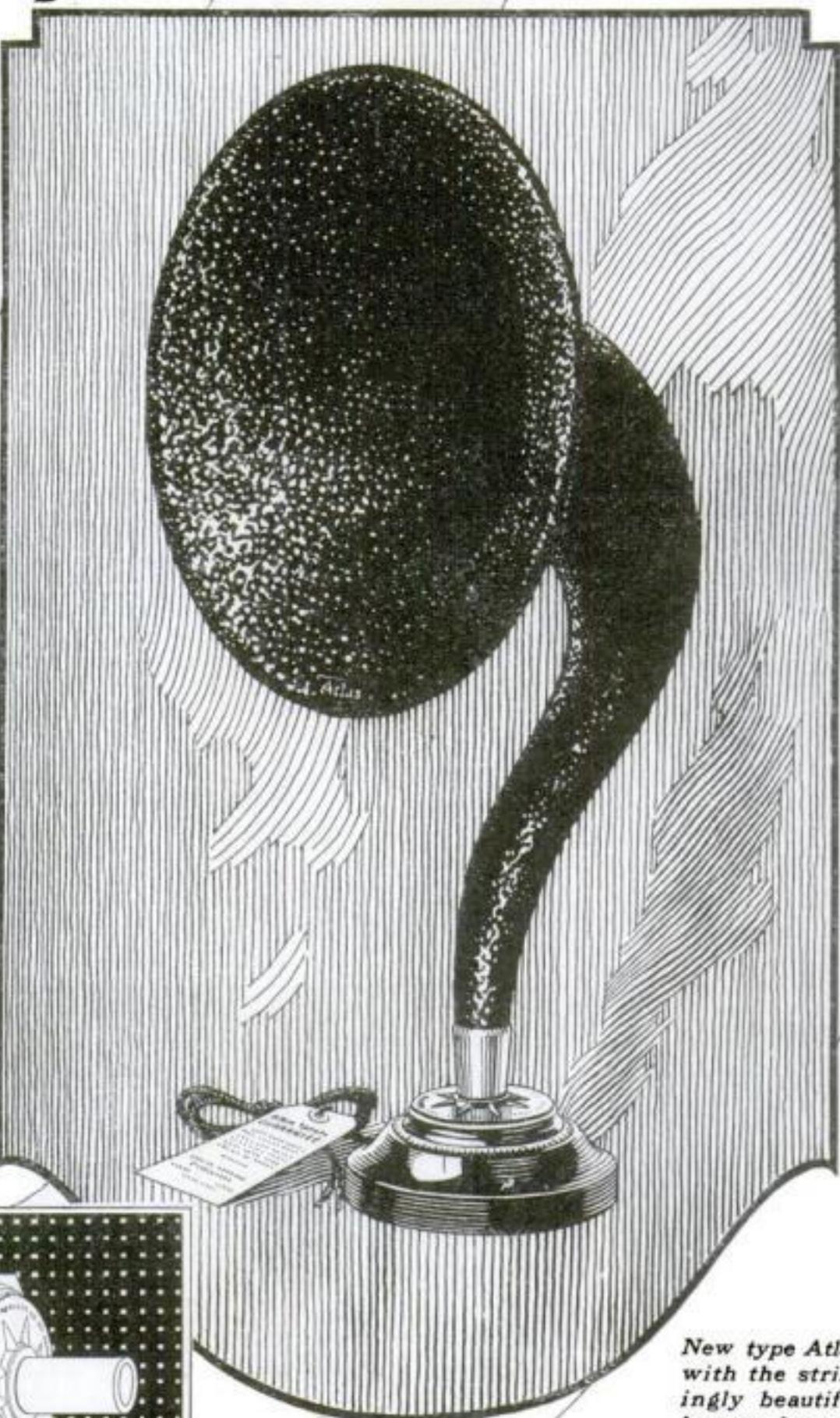
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